CAUSE Resiliency (West Coast) Experiment Final Report

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1. Acknowledgements:

The CAUSE Resiliency (West Coast) experiment 2011 was one of a series of projects jointly sponsored by the Department of Homeland Security (DHS) and the Defence Research and Development Canada (DRDC).

2. Contents

3. Abstract

The CAUSE Resiliency (West Coast) Experiment jointly sponsored by the Department of Homeland Security (DHS) and the Defence Research and Development Canada (DRDC) was conducted in June 2011. Emergency management communities in British Columbia and Washington State participated and were exposed technologies that have recently been developed or are nearing operational maturity. This report provides an overview of the experiment and summary of the findings and recommendations.

Resume

En juin 2011, des organismes de gestion des urgences opérationnelles en Colombie-Britannique et dans l'État de Washington ont participé au projet expérimental CAUSE Resiliency (côte ouest), parrainé conjointement par le département de la Sécurité intérieure (DHS) et Recherche et développement pour la défense Canada (RDDC). Ils ont été exposés à des technologies récentes ou approchantes la maturité opérationnelle. Ce rapport donne un aperçu de l'expérience, en plus de résumer les résultats et les recommandations.

4. Executive Summary

4.1 Project Overview

4.1.1 The CAUSE Resiliency (West Coast) experiment 2011 was one of a series of projects jointly sponsored by the Department of Homeland Security (DHS) and the Defence Research and Development Canada (DRDC).

4.1.2 The project was designed to demonstrate newly operational and emerging technologies and inform future research and development. One key goal was to enhance systems interoperability between Canada and United States partners.

4.1.3 The experiment exposed a number of technologies and integration options, and engaged operational emergency management communities in British Columbia and bordering organizations in the North West United States.

4.2 Organizations, Scenario and Technology Involved

4.2.1 Five different organisations and sites were involved. The planning, script development and system integrations were conducted over a period of seven months, and execution of the experiment carried out on 21 June 2011. Film crews and cameras were present in all locations to capture the action as the scripted scenarios were played out to explore the technologies.

4.2.2 The operational organisations and locations involved were: Emergency Management British Columbia (EMBC), the City of Richmond, the City of Vancouver, Pacific Northwest National Laboratory (PNNL) and Washington State Emergency Management Division.

4.2.3 The background scenario establishing context for the emergency response in all locations was a major Cascadian subduction zone earthquake off the coast of Oregon of magnitude 9.0. A series of vignettes were developed and scripted based on various time slices before and after the main event.

4.2.4 The technologies and project participant involved in the experiment included the following : BCeMap (ESRI/GeoBC/Citizens Services BC), HAZUS (NRCan / FEMA) , Ushahidi (Simon Fraser University), E Team (NC4), Fusionpoint and Smart Client (EmerGeo), a CAP/Atom Scenario Generator (Planetworks), the Multi-Agency Situational Awareness System (MASAS) National Implementation Team (NIT), SA Mapper (PNNL) MyStateUSA and the Integrated Public Alerting and Warning System (IPAWS - FEMA), AMECom truck (Simon Fraser University).

4.3 Summary findings and Recommendations - overall findings

4.3.1 A summary of the findings and associated recommendations relating to both the overall conduct of the project and each technology are summarised below:

Overall	
Findings	Recommendations
- The experiment enabled a number of integration options to be explored and evaluated with minimal cost. The nature of the sponsorship/funding allowed multiple provincial, municipal, vendor and research establishments to participate and interact in a low cost and low impact manner.	- Continue to run implementation trials and/or pilots to demonstrate the feasibility and benefits of using emergent applications and tools to support Emergency Management. These could be run under the CAUSE framework and involve US participants or could also be performed Provincially subject to funding.

Overall	
Findings	Recommendations
- Creating the integrations between the tools in the experiment determined that these systems could provide most of the information needed for awareness purposes. The integrations could geospatially place many Emergency Management information products (such as situation reports and resource requests) and the linkages are present in the alerting messages to allow users to click through to such reports if they were published in such a manner. - Making a film of the project was a very effective means of illustrating and disseminating information regarding the project, the tools, and the capabilities of the integrations. The documentary has proven popular amongst the emergency management community and is being used extensively for conferences and for fundraising and educational purposes.	- A small amount of seed funding could encourage agencies to procure incident management and awareness tools that are MASAS enabled. It is suggested that the Province establish some guidelines and standards for interconnected systems, and that a fund be created that can grant money to individual agencies that comply with these guidelines (including MASAS interfaces). - Introduce an annual provincial interoperation test exercise, similar to the integration aspect of the CAUSE experiment, where all operationally connected systems are enhanced to the latest interface standards, and the changes are then tested through exercise of an operational scenario involving actors in each location. Each agency involved would play a part in acting out the information flows and validating and testing the versioning of the interfaces.

HAZUS (Vignette 1)	
Findings - see section 7.4	Recommendations - see section 7.5
- HAZUS provided useful information for the municipality understanding the impact of a major earthquake. - HAZUS could bring together much of the existing Critical Infrastructure, building and population information, and also the multiple threat models applicable to the city. - There was concern over the resource required to gather and process the information, the security of information generated and how much the models could be trusted. - Other USGS/FEMA tools might also be applicable for use by the city (e.g. real time feeds, PAGER/Shakemaps and Shakecast).	- The City of Richmond might evaluate HAZUS further and develop an understanding of resources required to maintain the HAZUS model and information sources. - Future experiments could explore the use of the HAZUS output models and interfaces being developed by NRCan (e.g. CommunityViz and web services being developed by Galdos). - It is recommended that the NRCan research should be developed into a standard provincial framework for community threat and risk modelling, with support for collaboration and sharing of resources, development of information sources, threat scenarios and tools for storage and dissemination using HAZUS as a core tool in the process. - Future experiments could explore the use of Shakecast (running off similar data as gathered from HAZUS).

Emergeo / AMECom truck (Vignette 2)	
Findings - see section 8.4	Recommendations - see section 8.5
- the EmerGeo Fusionpoint product demonstrated the usefulness of map based incident and situational awareness system and the availability of this information for remote decision makers. - the EmerGeo Smart Client demonstrated how a live input from United States Geological Survey (USGS) can generate ground shake models and an initial assessment of the potential earthquake impacts - Web Mapping Service (WMS was explored as a potential integration between Fusionpoint and BCeMap, however additional development would be required to make this fully functional.	- It is recommended that the city of Richmond procure and implement an incident management and situational awareness system such as EmerGeo Fusionpoint, such that incidents can be tracked and managed by local managers and can be accessed remotely by decision makers. - It is recommended that such a system should be capable of consuming and publish alerting messages via the Multi-Agency Situational Awareness System (MASAS) for sharing information with other neighbouring jurisdictions and the province. - There is overlap between the capabilities of Fusionpoint and BCeMap and if both have access to the same sources (e.g. MASAS then only one would be needed). In the absence of a local system, BCeMap could be made available for situational awareness purposes. - It is recommended that various critical infrastructure operators (for example Vancouver International Airport) could be approached to develop operational procedures to implement the AMECom truck to support recovery of critical communications and/or power services.

Ushahidi (Vignette 3)	
Findings - see section 9.4	Recommendations - see section 9.5
- The Ushahidi web site was an easy to use application for submission of public reports. - The experiment demonstrated that the City of Vancouver 311 contact centre team could effectively evaluate Ushahidi reports and create ETeam call centre records. These could then be converted to incident reports by Emergency Managers if deemed appropriate, and published as map events in BCeMap.	- It is recommended that the process explored in the experiment is developed into an operational process for use in the case of a major incident or event. - A means by which operators could initiate an automatic extraction of report data and location information from Ushahidi into ETeam would be beneficial in terms of saving time. - Similar interfaces from Facebook and Twitter should also be considered. - It is recommended that policies and media strategies are developed around publicising the existence of event-related Ushahidi sites or any other social media sites deemed useful for the public. This should also include outbound communications (e.g. publicising reception centres or people finding services).

BCeMap / MASAS / CAP/Atom Scenario Generator (Vignette 4)	
Findings - see section 9.4	Recommendations - see section 9.4 and Appendix A
- The experiment sponsored the implementation of an interface on BCeMap that consumes messages from the latest generation of MASAS alerting messages. - The experiment allowed a significant amount of testing with real CAP messages and the identification of issues (e.g. with NRCan earthquake feed), and for subsequent fixes to be made - The CAP/Atom Scenario Generator, built specifically for the experiment, proved very useful for driving the scenarios. This tool is now published as an open-source component on the MASAS project web site and has been used for other exercises since. - The update periodicity of the BCeMap feed processes is deemed to be too infrequent for the real-time nature of data coming through MASAS.	- It is recommended that the improvements to the BCeMap delivery process are implemented as listed in section 10.5. - It is recommended that BCeMap is upgraded to the latest version of the Flex API such that the open source MASAS ESRI Flex Tools (MEFT) can be implemented in BCeMap and can therefore consume alerting messages direct from MASAS. This would solve the issue with the update frequency and speed of the feed processing, and also minimise any potential compatibility issues with future messages transmitted through MASAS. - It is recommended that BCeMap should be upgraded to a multi-site redundant server architecture for increased resilience. - It is recommended that the CAP/Atom message generator is enhanced for multi-language support, ability to send alert updates, and other general improvements (user interface, coding standards). - The list of CAP-CP event types could be augmented with types to cover sensor outputs and also a standard means of indicating recent updates. - A project could be established between EMBC, UBC and the BC SIMS Ministry of Transportation to develop an output from the bridge sensors and strong motion ground sensors in the SIMS project for use in MASAS and BCeMap.

Livewall/ SAMapper (Vignette 5)	
Findings - see section 11.4	Recommendations - see section11.5
- Livewall experienced a number of issues, including hardware, network and software related faults, some of which were overcome but ultimately a disk failure rendered the solution unavailable for the experiment at the Canadian end. - SAMapper was bridged through an adapter on the CAP/Atom Scenario Generator through to MASAS and from there to BCeMap to demonstrate cross border interoperability.	- SAMapper could be considered as a simple application for gathering tagged images from field devices operated by first responders. This could be compared to other similar applications (including Ushahidi). Such a project would need to consider the operational procedures related to the gathering process and also the hardware planned for such frontline users. - Although it was demonstrated that direct connection to Canadian parties through MASAS is technically feasible, it is recommended that any operational alerting messages from the US transit via IPAWS for consistency and compliance with national standards and policy.

MASAS / IPAWS / MyStateUSA (Vignette 6)	
Findings - see section 12.4	Recommendations - see section 8.5
- Through an integration between IPAWS and MASAS, it was possible to interchange data between BCeMap in Canada and MyStateUSA in the United States. - The initiative received strong support from the participants and there is significant interest in pursuing this further amongst all parties. This has led to operational and technical MOUs signed between DRDC and FEMA to further develop the integration. - There were some challenges in terms of stability and compatibility of the VPN network connection, evolving code bases and message content incompatibilities. - The experiment demonstrated the benefit of system-to-system messages allowing information to flow that might normally be limited by the hierarchical nature of cross- border relations.	- It is recommended that further projects are pursued to develop the governance, operational procedures, technology, training/exercises and real-usage testing that would allow the effective implementation cross-border alerts. - Such project initiatives might engage senior management at FEMA IPAWS, NIEM PMO (National Information Exchange Model Program Management Office) and the PM ISE (Program Manager for the Information Sharing Environment) organizations. - It is recommended that IPAWS is enhanced to allow CAP-CP messages to be passed natively and not limited by the strict CAP-IPAWS rules. - It is also recommended that the CAP-IPAWS event code list is expanded and mapped to the CAP-CP event code list, or to develop a shared event code list that is not profile specific but can be included in CAP messages to ease translation between more localized event code lists.

5. Participants/Acknowledgements

5.1.1 Special thanks are offered to all the participants in the project as listed in the table below.

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6. CAUSE Resiliency (West Coast) Experiment 2011 Project

6.1 Introduction

6.1.1 This project is part of an annual series of experiments sponsored by Command, Control and Interoperability (CCI) Division of DHS and the Centre for Security Science (CSS) of DRDC.

6.1.2 These experiments are intended to showcase newly operational/emerging technologies, to guide future research and development and to improve interoperability. They involve:

- Design, planning, preparing, conduct, after-action analysis, and experiment outreach activities
- Cross-border systems-integration and information sharing across U.S. States and Canadian Provinces
- Collaboration between US and Canadian first responders and emergency managers
- Multi-jurisdictional and cross-border coordination in response to a natural disasters as well as ability to handle all other hazards

6.1.3 The projects should generate leave-behind benefits in terms of enhancements to fielded technologies (and their use) and/or to other steps on the SAFECOM "Interoperability Continuum"[1] (i.e. improvements to Governance, Standing Operating Procedures, Technology, Training and Exercises or Usage).

6.1.4 The CAUSE Resiliency (West Coast) Experiment 2011 project began in the summer of 2010 for the Canadian participants; it started with a workshop hosted at the Justice Institute of BC which was attended by a number of interested Canadian and US stakeholders. It was agreed at that workshop to target a May 2011 implementation timeframe and lists of candidate technologies and participants were identified and discussed.

6.1.5 Emergency Management BC became the sponsor in situ for the project and provided overall governance, prioritisation and guidance with respect to participation and technical interest Funding was provided by the DRDC and by in-kind contributions from participants. The main execution was coordinated with the US counterparts, with the experiment ultimately conducted on 21st June 2011, working around other provincial commitments relating to spring flooding this year.

6.1.6 The project was managed by Planetworks Consulting Corporation who facilitated a series of focussed meetings, workshops and bi-weekly update sessions with the stakeholders, international (US) partners, suppliers and the technical resources involved as the project progressed. Contracts were put in place and managed by Planetworks for specific integration designs, open-source developments, and hosted instances of commercial software, all required to build the environments necessary for the experiment, and to ensure the resultant leave-behind components and technology improvements.

6.1.7 The CAUSE 2011 project was filmed in the primary Canadian locations and included interviews with stakeholders in Ottawa and in the main US location. The intent is to produce a documentary of the process for wider distribution. A local film production company, Screaming Black Dog Productions, was engaged for this purpose and was involved in experiment planning and script development to assist in recording the event.

6.2 Objectives of Experiment

6.2.1 The project envisioned for the CAUSE Resiliency (West Coast) Experiment 2011 was designed purposefully to engage the operational emergency management communities in British Columbia and bordering organizations in the United States, and to demonstrate the use and integration of some emerging technologies that have recently been developed or are near operational readiness.

6.2.2 The overall goals were to:

- Encourage adoption and active use of those technologies;
- Demonstrate multi-jurisdictional and cross-border collaboration;
- Guide future research and development activities; and
- Further the interoperability and value of existing tools

6.2.3 The project output includes this report which contains specific recommendations for future research and development activities, as well as providing suggestions for initiatives that could be undertaken by participating organisations.

[1] http://www.safecomprogram.gov/SiteCollectionDocuments/Interoperability_Continuum_Brochure_2.pdf

6.2.4 The documentary output of the project is in post-production at the time of writing, and is being aimed at several target audiences including:

- EOC operators/managers, who need to appreciate what the tools do, and why they should care;
- Science & Technology managers, who are looking to gain insight into how their outputs are making a difference in operations;
- Regional managers at all levels, who may be unaware of the maturity of tools that are actually going operational, or have recently become available; and
- Senior decision makers at Federal and Provincial level, who may be recipients of the video clips at briefings and who, it is hoped, would be impressed with the value of outputs that are being generated at the program level, and by the resulting “interoperability enhancements”.

6.3 Overview of the Experiment Approach– Canadian Participation and US Partnership

6.3.1 The CAUSE 2011 project consisted of two main sub-projects. The Canadian sub-project was managed by Planetworks on behalf of the CSS, DRDC. The other US project was managed by the PNNL based out of Seattle, WA and sponsored by the DHS, CCI division.

6.3.2 Somewhat different approaches to achieving the common goals were adopted by each. This variance stemmed mainly from dissimilar technology selection processes.

6.3.3 The Canadian project focused on key technologies that were of interest to select operational parties who were consulted as the process evolved. These tended to be technologies that were known to be close to production-ready or already in use, and it was felt that this experiment presented an opportunity to evaluate and explore various technical integrations or operational combinations.

6.3.4 The PNNL approach was to explore a significant number of technologies (the evaluation list exceeded 36 products) that were funded previously by DHS programs and to evaluate their fit and merit in an emergency management context. This was not necessarily the customer base that a number of the technologies were developed for.

6.3.5 Once the respective technologies were determined, the process to determine possible interoperability between the Canadian technologies and US technologies, and matching operational scenarios that might illustrate interaction between participating agencies north and south of the border began.

6.3.6 Figure 1 illustrates the timelines of the phases of the project. Participating Canadian agencies were identified early in the process, with some integration developments initiated in early 2011. Exploration of integrations and implementation continued through until late in the process.

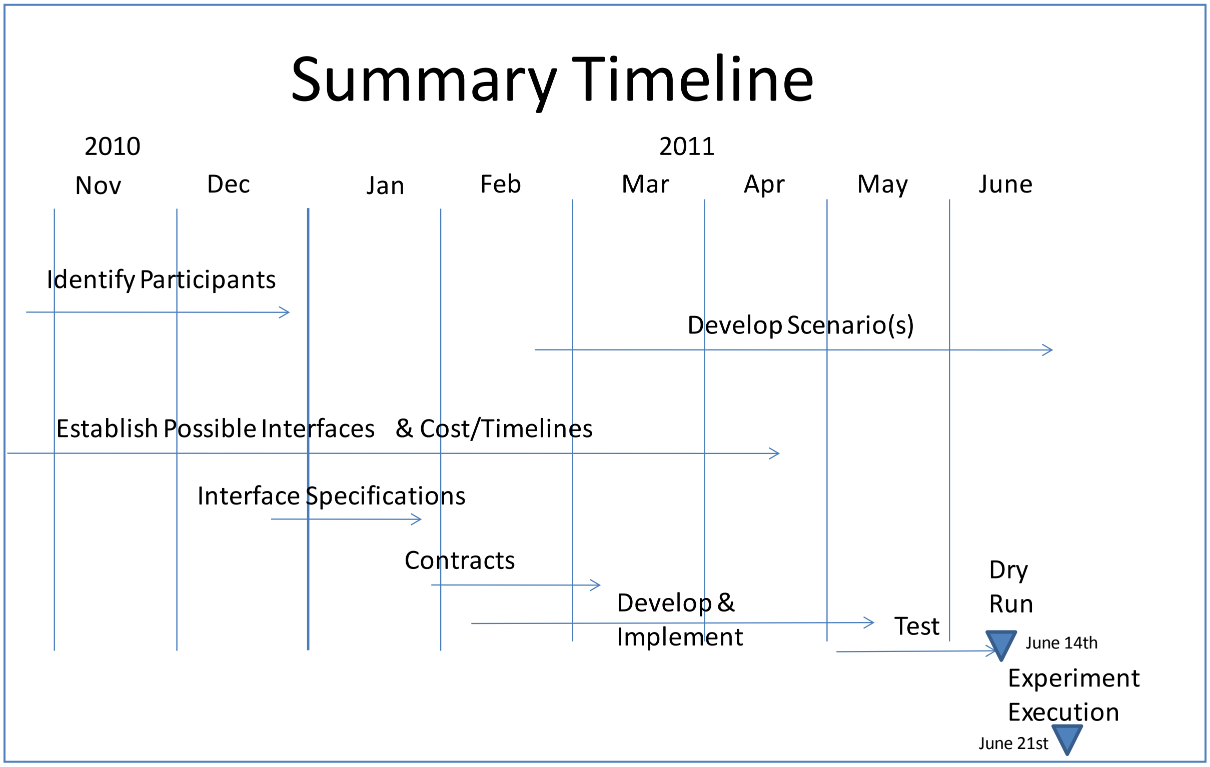


Figure 1 - Project Timelines

6.3.7 Operational scenario development, including the development of the data test packs required to provide context for the scenarios, also ran through until the live experiment date. By the time of the dry-run date most of the technologies were available or had been made available to the participating agencies, allowing final touches to be made to the main script, ready for the main execution date a week later.

6.3.8 Filming was also carried out on the dry-run date. This provided an opportunity for the experiment logistics to be rehearsed and the timing and movement of film crews with participating groups and actors to be practised, and for network connectivity to be tested, web cast installed and issues to be identified. Filming on this day allowed "B Roll" to be captured i.e. backup footage to fill gaps on the main shoot, in some cases the sequences were good enough not to need repeating on the main execution day, allowing more time for other segments.

6.4 Participation and Technologies of Interest

6.4.1 North of the border, the following participants agreed to be part of the experiment. Their specific interests are also listed (these technologies are referenced in this section and explained in more detail in section 6):

- EMBC, in particular the South West Provincial Regional Emergency Operations Centre (PREOC), which was interested in additional information sources including the Multi-Agency Situational Awareness System (MASAS) alert messages for BCEMap which is the provincial emergency mapping tool, and also sources listed below (EmerGeo and Hazus-MH). EMBC were also interested in the possibility of Tsunami alerts being generated through MASAS for BC and also the use of Hazus-MH for developing consistent threat/hazard and damage models across municipalities in the province.
- Vancouver Emergency Management and Vancouver City 311 Call Centre, which were interested in using social media and crowd sourcing tools such as Ushahidi to gather information from the public and have incident information created as a result in the formal emergency management systems (E Team and BCeMap).
- Richmond Emergency Management, which was interested in exploring an on-line emergency management tool called EmerGeo Fusionpoint, and the EmerGeo Smart Client tool and also willing to evaluate use of a risk and damage assessment tool called Hazus-MH.

6.4.2 The main expenditure on interfaces as part of the project was for the MASAS/BCeMap interface, for which a contract was negotiated with ESRI in early 2011. The main scenario generation tool development was also started in early 2011. Other possible integrations between EmerGeo, Hazus-MH and BCeMap were identified and progressed in

parallel. Testing of the integrations ran through until the dry run date, and up until the main execution date.

6.4.3 One of the systems that were considered for inclusion in the experiment was the BC Smart Infrastructure Systems (BCSIMS), a project being managed by the University of British Columbia (UBC) on behalf of the Ministry of Transportation. Conceivably this system might have provided two important sources of information for MASAS/BCeMap in the context of a major earthquake i.e. input from strong motion sensors, which would give readings for the level of shaking at various locations, possibly an iso-map of intensity of the effects of the earthquake, and also input from bridge seismic sensors which would indicate where bridges have exceeded their design limits.

6.4.4 Unfortunately, due to other project pressures on BCSIMS team, this was not possible for this experiment, and the input was simulated instead using a message generation tool in order to provide input into the scenarios. It is recommended however that a future experiment would provide a means for implementing this feed from BCSIMS into MASAS and therefore to other consuming systems.

6.5 Canadian / US Interoperation

6.5.1 One significant focus of the CAUSE 2011 project was the interoperation/integration between Canadian and US organisations and technologies.

6.5.2 A number of explorations were made in both the Canadian and USA projects to find potential interest and partners between the major interoperability technologies in the USA, including Virtual USA (a project to develop GIS interoperability standards between agencies) and projects relating to the Unified Incident Command and Decision Support (UICDS) middleware. Figure 2 shows a diagram covering the potential integration concepts that were explored. There was significant interest in many of the related projects that might have been persuaded to be extended to encompass a cross border component. However in most cases the level of work required, as well as the lead-time involved in confirming the budget and assigning development resources proved impractical in the time available.

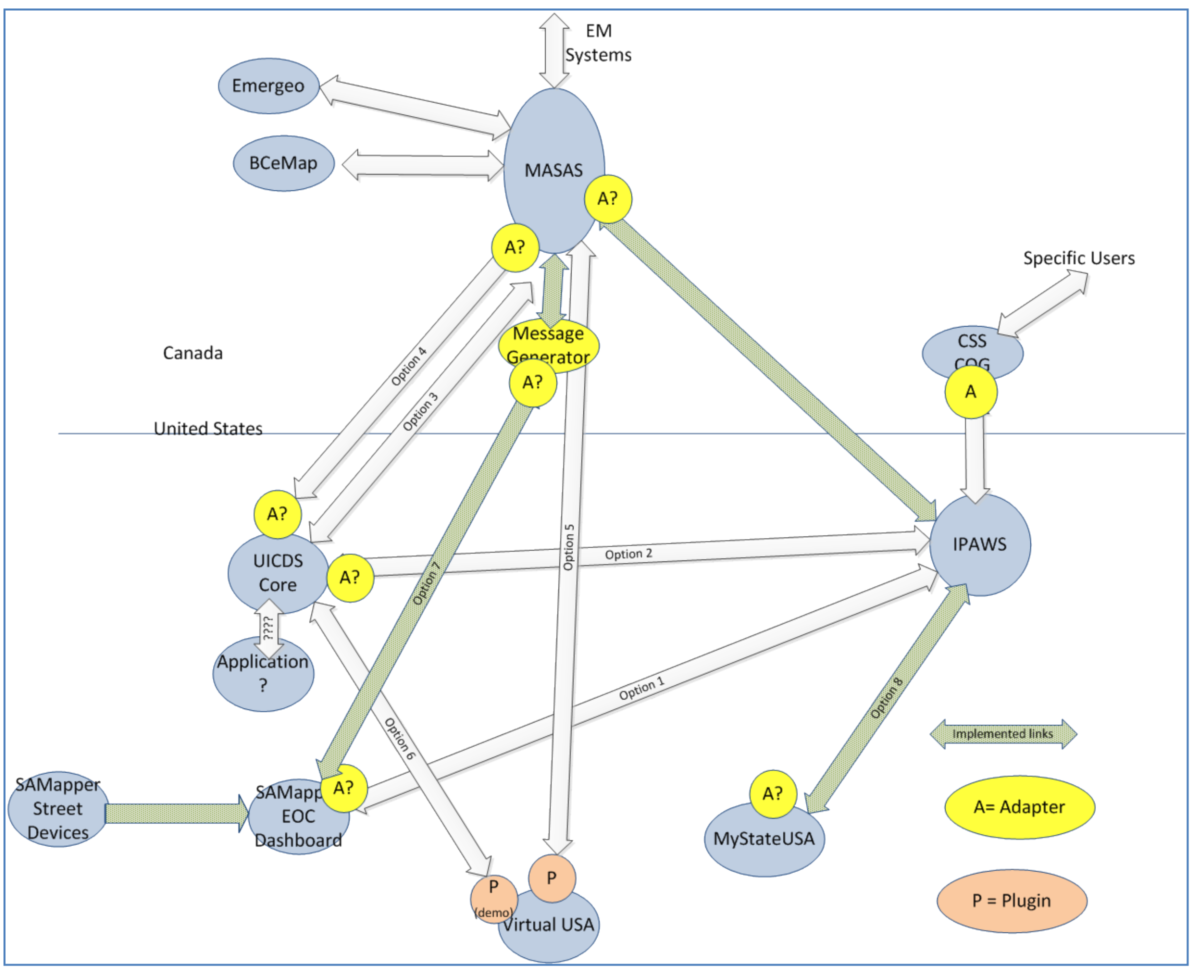


Figure 2 - US/Canadian Integrations

6.5.3 Two cross-border initiatives were taken forward however. These were, in summary:

6.5.4 **SAMapper Integration**: The simplest integration was Option 7 in Figure 2, where a tool called SAMapper, one of the tools chosen in the US project required a small amount of development that enabled delivery of that product's database contents via XML over http, which could be picked up by an adapter at the Canadian end, essentially an add-on to the scenario generation tool built for the project, which could then re-publish to the MASAS hub and for consumption by any system connected to MASAS (including BCeMap).

6.5.5 **MyStateUSA>IPAWS>MASAS Connection Development**: Another track that was also successfully explored, through the MASAS National Infrastructure Team (NIT) who reached out to the Washington State Emergency Management Department and their Emergency Operations Center which uses a MyStateUSA system to issue and receive CAP alerts through DM Open (subsequently migrated to IPAWS OPEN in June of this year). MyStateUSA was contacted and they were keen to be involved in order to develop the MyStateUSA brand in Canada. A contract resource was engaged by CSS to move the project forward, develop the operating scenarios and work with the MASAS NIT to coordinate development of the MyStateUSA>IPAWS> MASAS connections.

6.5.6 As a result of these initiatives, two cross border technical connections were incorporated into the master scenario and into the vignettes that were used to engage the emergency management organizations involved.

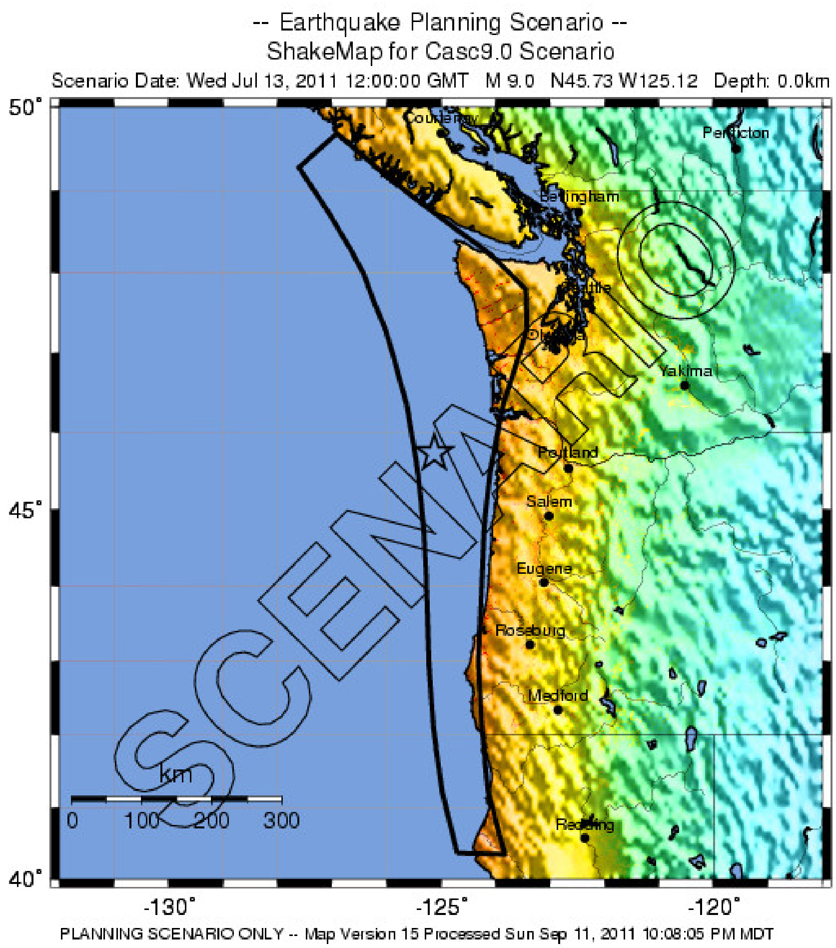
6.6 Overview of the Experiment Execution – Master Scenario and Locations involved

6.6.1 The experiment itself involved a series of vignettes that, in turn, were based on a master scenario that was developed around a large Cascadian subduction zone earthquake of Magnitude 9.0. This provided context for the time slices chosen for the vignettes. These were points in time where information flows around the event and related incidents were simulated, involving information moving between systems and engaging players in different locations in dialogue around those information flows.

6.6.2 For a magnitude 9.-0 subduction earthquake, it would be normal to expect tens to hundreds of aftershocks over a period of a few weeks. A few of these aftershocks would be a magnitude between 6 and 7.5, possibly within an hour of the main event but more likely to occur later. Aftershocks can occur in a cluster.

6.6.3 The location of the aftershocks would be random. The main rupture may be 500-800 km long and aftershocks could be in any of the fault lines in the region.

6.6.4 The baseline scenario used for the CAUSE 2011 project was one of the scenarios published by the USGS at http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/Casc9.0_se/ and illustrated in Figure 3.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Figure 3 - Cascadian 9.0 Planning Scenario

6.6.5 The locations involved in the experiment, and the approximate location of the major earthquake are shown in Figure 4.

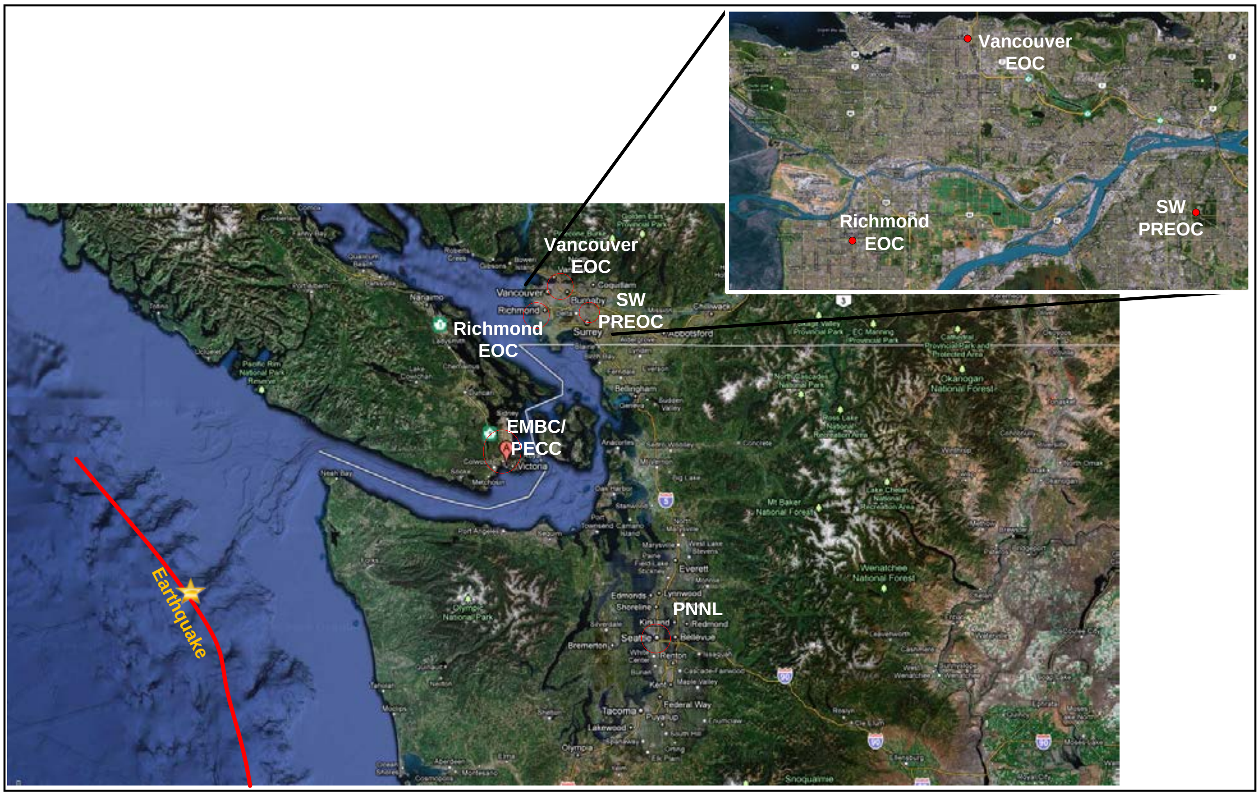


Figure 4 - Experiment Locations

6.6.6 The Canadian locations involved in the experiment were as follows:

- The Provincial Emergency Coordination Centre (PECC).
- The South West Provincial Regional Emergency Operations Centre (SW PREOC). Located at 14275, 96th Avenue, Surrey.
- The Vancouver Emergency Operations Centre. Co-located with the Emergency Communications for South West British Columbia, 3301 E Pender Street, Vancouver.
- The Vancouver City 311 Call Centre. Co-located with the Emergency Communications for South West British Columbia, 3301 E Pender Street, Vancouver.
- The Richmond Emergency Operations Centre. Located at: 6911 No. 3 Road, Richmond

6.6.7 The emergency management command and control protocols in British Columbia follow an Incident Command Systems (ICS) in accordance with the British Columbia Emergency Response Management System (BCERMS). The processes followed in the experiment reflected these protocols, with some license taken for the sake of dramatization, for example omitting the initial processes for opening up communications with US counterparts, or allowing communication situation reports to be provided verbally rather than on paper.

6.6.8 The PECC provides policy direction, coordinating the overall provincial response and resources, establishing provincial government priorities, liaising with federal and international assistance agencies and supporting a 24/7 incident reporting line for the province.

6.6.9 The SW PREOC is one of five provincial emergency operations centres, whose role is to coordinate and prioritize the province's response to emergencies and disasters within a designated region, in this case the lower mainland area, and also to coordinate provincial and agency support for local authorities, First Nations or other provincial ministry or agencies. The PREOC also reports directly to and takes policy direction from the Provincial Emergency Coordination Centre. Reports include situational information on events within the region as well as resource requests in situations where appropriate and/or where sufficient resources are not available within the region.

6.6.10 The Vancouver and Richmond Emergency Operations Centres undertake planning to maximize the protection of life, public infrastructure, private property and the environment for their respective communities in the event of a major emergency or disaster. The centres also conduct emergency operations to protect life and property. The EOC is a facility where key city personnel and other response agencies gather to provide policy direction to the on-site incident commanders, as well as to co-ordinate resource requests from the incident sites. Their role is also to sustain business

operations and to rebuild in order to restore economic viability after an event.

6.6.11 The Vancouver 311 Call Centre is the call handling service for the Vancouver City citizens' service line that handles citizen requests for service, information and reporting concerns.

6.7 Overview of the Experiment Execution – Vignettes

6.7.1 Over the course of the experiment development a number of vignettes were developed against the backdrop of the overall scenario. These were evolved, and the storyline script developed as the integrations were implemented and the touch points with the US organizations were developed. The detailed script, included at Appendix B, was used to guide the actors in using the technologies and the dialogue for the filming.

6.7.2 Figure 5 illustrates how each of the technologies was employed to implement information communication between organizations and locations and was used to support the dialogue.

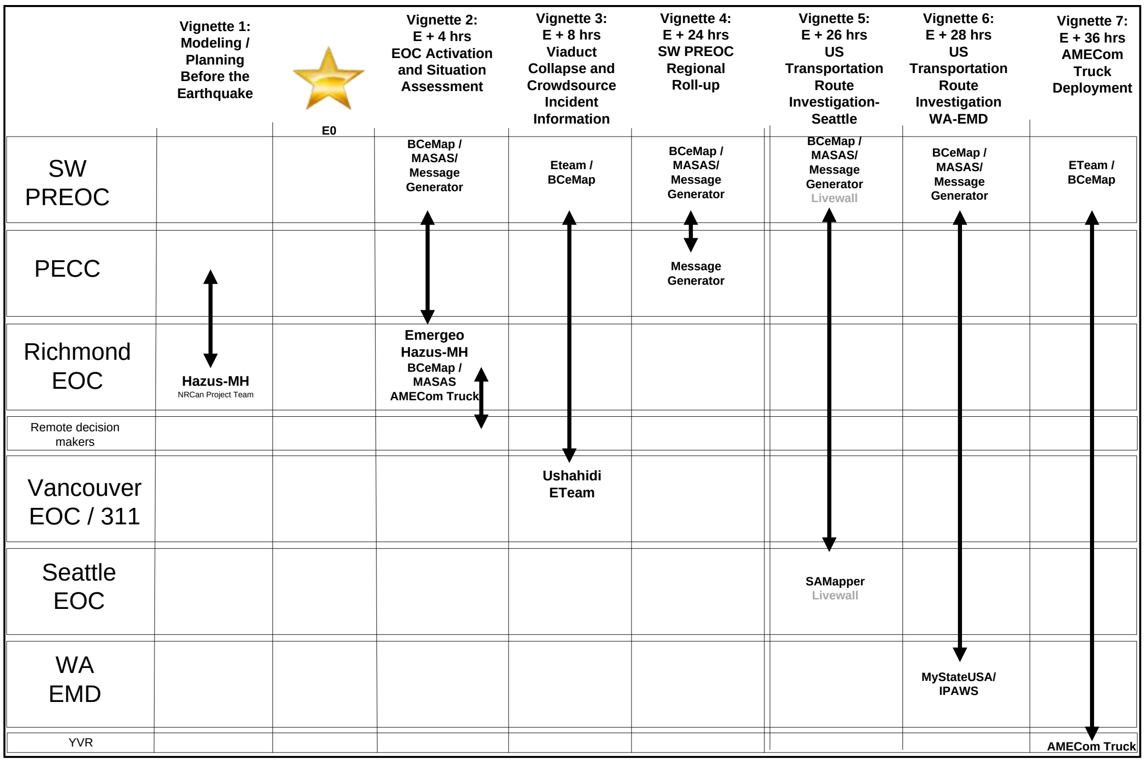


Figure 5 - Overview of Vignettes Locations Inter-operation and Technologies

6.7.3 **Vignette 1: Modelling/Planning before the earthquake event:** Involved a planning session between a NRCan project team and the City of Richmond, using a damage assessment and modeling tool called Hazus-MH. A dialogue was also supported with the Provincial Seismic Specialist (based at EMBC/PECC) and an integration between Hazus-MH and the provincial emergency awareness map tool called BCeMap. This vignette is described in detail in section 7. The ability to run some risk and damage assessment models for Richmond was made possible by a significant NRCan project (funded under the DRDC CRTI umbrella) that developed generic data sources for Metro Vancouver (an area which includes Richmond). The vignette was designed to expose Richmond Emergency Management to the Hazus-MH tool, the risk assessment process and the possible outputs for use in planning against specific threat scenarios.

6.7.4 **Vignette 2: EOC Activation and Situation Assessment**: Based around the activation of the Richmond EOC, including the initial briefings for staff as they arrived, using EmerGeo Fusionpoint as the incident management system and consolidated dashboard, as well as using the EmerGeo smart client to assess the potential ground shake effects. A briefing dialogue is held between Richmond EOC and the SWPREOC, including use of an output from EmerGeo Fusionpoint. Several Hazus-MH outputs relating to Richmond were also published to BCeMap (to be visible to the SWPREOC) during the briefing, exploring the integrations of these tools.

6.7.5 **Vignette 3: Viaduct Collapse and Crowd-sourcing Incident information:** Involving several locations, the vignette simulated a collapse of the Georgia viaduct, with members of the public reporting information into a crowd

sourcing application called Ushahidi. The City of Vancouver 311 Call Centre assessed the public reports within Ushahidi, and entering validated reports into the Vancouver EOC E Team system, ultimately allowing these events to appear in BCeMap and to be viewed at the South West PREOC.

6.7.6 **Vignette 4: SW PREOC Regional Roll-up:** In this vignette an overview briefing session was held, providing a roll-up of information across the Lower Mainland including information coming in from bridge sensors, strong motion ground sensors, messages generated by the PECC regarding tsunamis and EOC activations, municipal information from Richmond and Langley and highway information such as rock falls that effectively block access to the Lower Mainland and set the scene for investigating moving resources through the US in the following vignettes.

6.7.7 **Vignette 5: US Transportation Route Investigation - Seattle EOC:** This vignette was one of the touch points with the US projects, in which a situational briefing was held between the SW PREOC and the Seattle EOC (simulated during the PNNL demonstration session). The SAMapper interface to BCeMap via MASAS hub was used to illustrate the state of major highways in the Seattle area. This was important for the SW PREOC in assessing the possibility of moving resources between the interior and the Lower Mainland via the highways in the US.

6.7.8 **Vignette 6: US Transportation Route Investigation - WA EMD**– This vignette involved the integration of the MyStateUSA system used by Washington State Emergency Management Department and systems in Canada via the major US and Canadian alerting messaging hubs (IPAWS and MASAS). This supported a dialogue between the SW PREOC and Washington State Emergency Management Department regarding the state of highways across the state and between Seattle and the border.

6.7.9 **Vignette 7: Deployment of AMECOM Truck** - deployment of the Province's tactical emergency communication vehicle was requested and discussed with the City of Richmond in Vignette 2 and the deployment of the truck to Vancouver International Airport was simulated. Due to time, scheduling and budget limitations, this vignette was de-scoped and in the findings incorporated into Vignette 2 for the purposes of the report.

7. Overview of the Technologies Involved in the Experiment

7.1.1 The following sections give a brief overview of the technologies involved in the experiment from both the Canadian project and the American systems that were interfaces with. The details of the integrations are included in each of the vignette descriptions.

7.2 BCeMap

7.2.1 BCeMap is British Columbia's situational awareness and emergency mapping system. The system was developed by ESRI and hosted at GeoBC (now Citizens Services) on behalf of EMBC, the main sponsor of the project. The system is currently in production for use by the Provincial Emergency Operations Centres and brings together multiple static layers together with several dynamic data feeds to present a single browser based map for users.

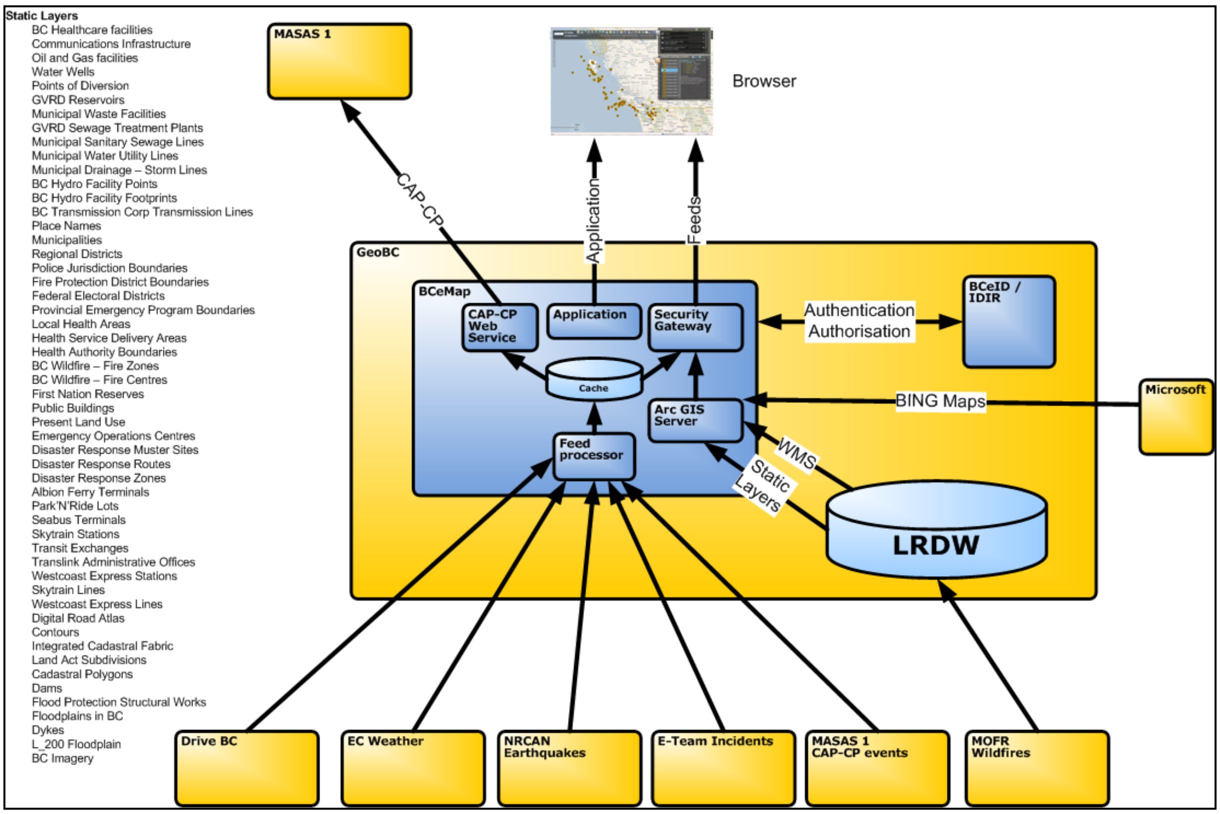


Figure 6 - BCeMap Architecture

7.2.2 Figure 6 shows the architecture of BCeMap, how the static layers and wild fire feeds are served up from the Land and Resource Data Warehouse (LRDW) together with feeds from Drive BC, Environment Canada Weather, NRCan Earthquakes, incidents from E Team, the provincial incident management system, and also a data feed from the original pilot version of MASAS (MASAS 1).

7.2.3 For the experiment, BCeMap was upgraded to be able to consume the latest MASAS II feed using a dedicated MASAS hub used for the experiment (to control the data sources during the experiment) and was also configured to use data from several WMS sources (NRCan Hazus-MH output and EmerGeo WMS output) in order to explore the possibilities of using BCeMap as a main delivery mechanism of such data to users.

7.2.4 For more detail on the BCeMap system, the upgrade project details and the recommendations see Appendix A.

7.2.5 BCeMap is in the process of being made operational for use in the PECC and PREOCs over the next few weeks, in parallel with training on E Team. It is anticipated that, in the spring of 2012, MASAS will be exposed more broadly across the province and that a further rollout of BCeMap to include participating Local Authorities and other EM stakeholders will be considered at that time.

7.2.6 A sample screenshot from BCeMap with the current Earthquakes feed active is shown in Figure 7.

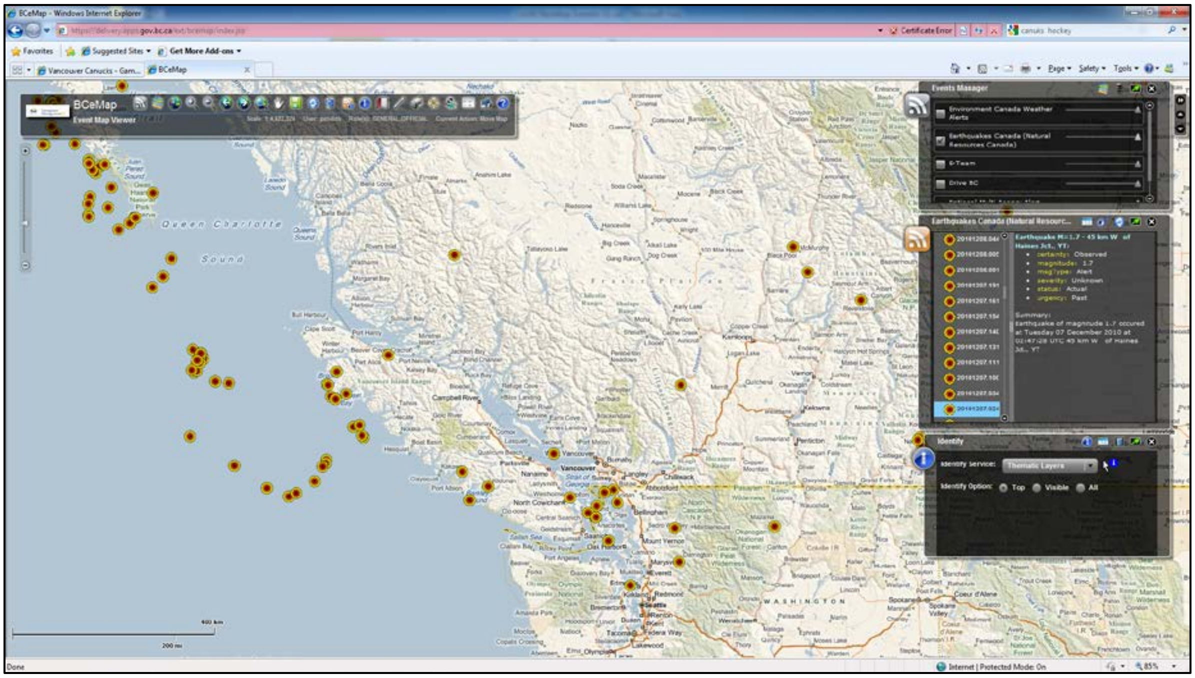


Figure 7 - Earthquakes in the region in normal times (a three week period in November 2010)

7.3 Hazus-MH

7.3.1 The National Resources Canada, Geological Survey of Canada Earth Sciences Sector has a mandate sponsored by CRTI to adapt a FEMA developed tool called HAZUS-MH for use in Canada, and to incorporate it into a broader framework for integrated risk assessment (Pathways-DM) that is aligned with the national All-Hazards Risk Assessment Framework (AHRA) that DRDC and Public Safety Canada are developing. Much of the work is aimed at allowing HAZUS to be used anywhere in Canada, using available data sources made accessible through an Asset Inventory Management System and using threat modeling developed specific to Canada's environment and geography.

Figure 8 - Image of Hazus-MH set-up screen

7.3.2 A project called "Methods and tools to compile a regional-level Asset Inventory Management System database in Canada" was set to up to explore the possible sourcing and integration of data from various sources to form the basis of a standard data set that would allow interested parties (e.g. municipalities and utilities) to start from a common

baseline and not have to perform the work themselves to obtain the data from those standard sources. Planetworks was involved in that project and was subcontracted to investigate sources, assist with agreements to use the data and also the technology to process and load into the Asset Inventory Management System (AIMS) database. This work directly supported the ability to run models in the context of Richmond since the scope was the region covered by Metro Vancouver (Greater Vancouver Regional District). The overall process is shown in Figure 9. The data developed for this project was used in the CAUSE 2011 experiment and the model outputs used in the vignettes.

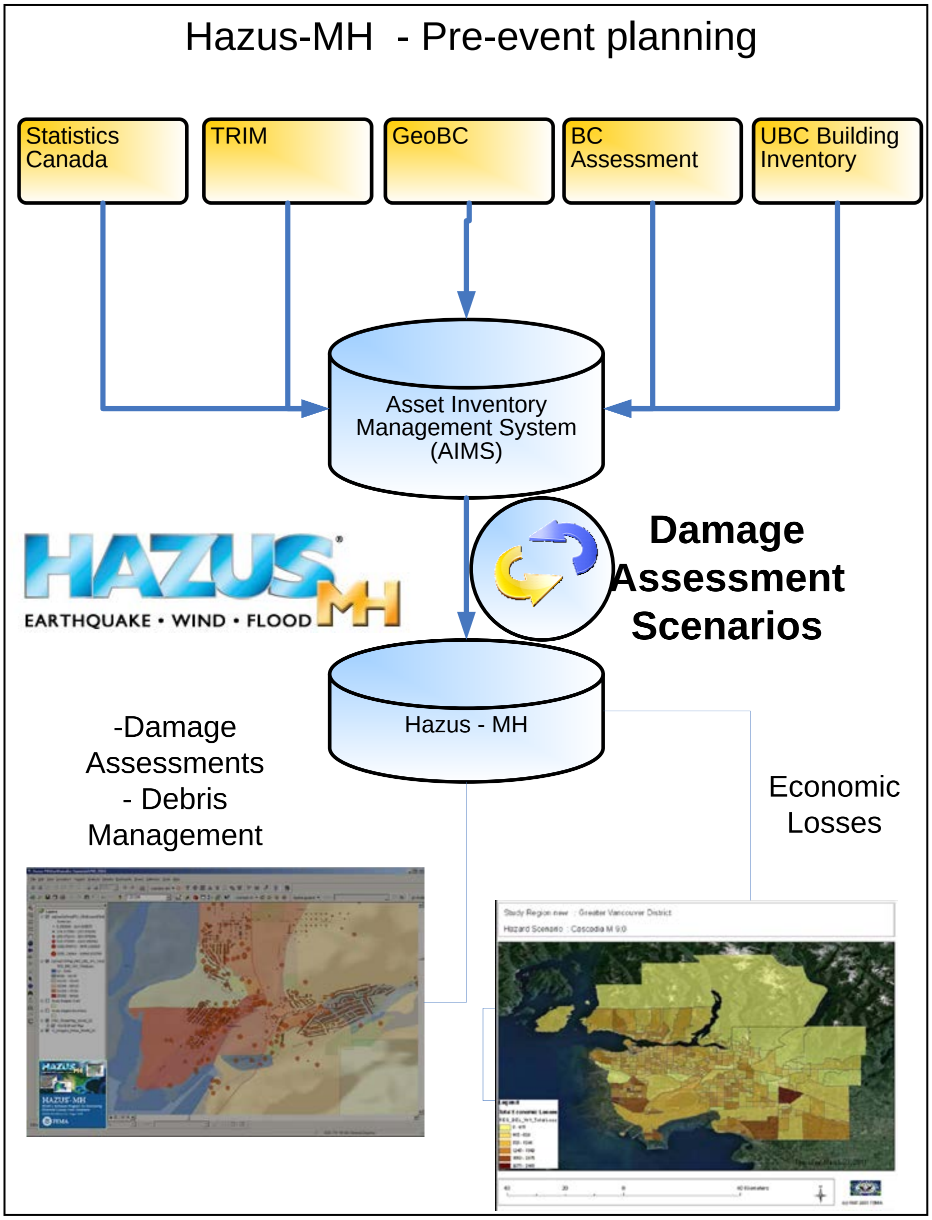


Figure 9 - Hazus-MH Process for Greater Vancouver

7.4 Ushahidi

7.4.1 Ushahidi is a non-profit technology company that develops free and open source software for information collection, visualisation and interactive mapping. The "Ushahidi Platform" is one of the tools developed by this community to allow crowd-sourcing of information from multiple channels, including SMS, email, Twitter and the web to create online reports that are visually represented on a map.

7.4.2 Volunteers or organisations create and host instances of the platform to support information gathering relating to events such as elections (to monitor ballot rigging), human trafficking or, pertinent to this project, large scale disasters,

such as the Christchurch or Japanese earthquakes.

7.4.3 The Ushahidi site set up to track infrastructure damage in Christchurch is shown in Figure 10.

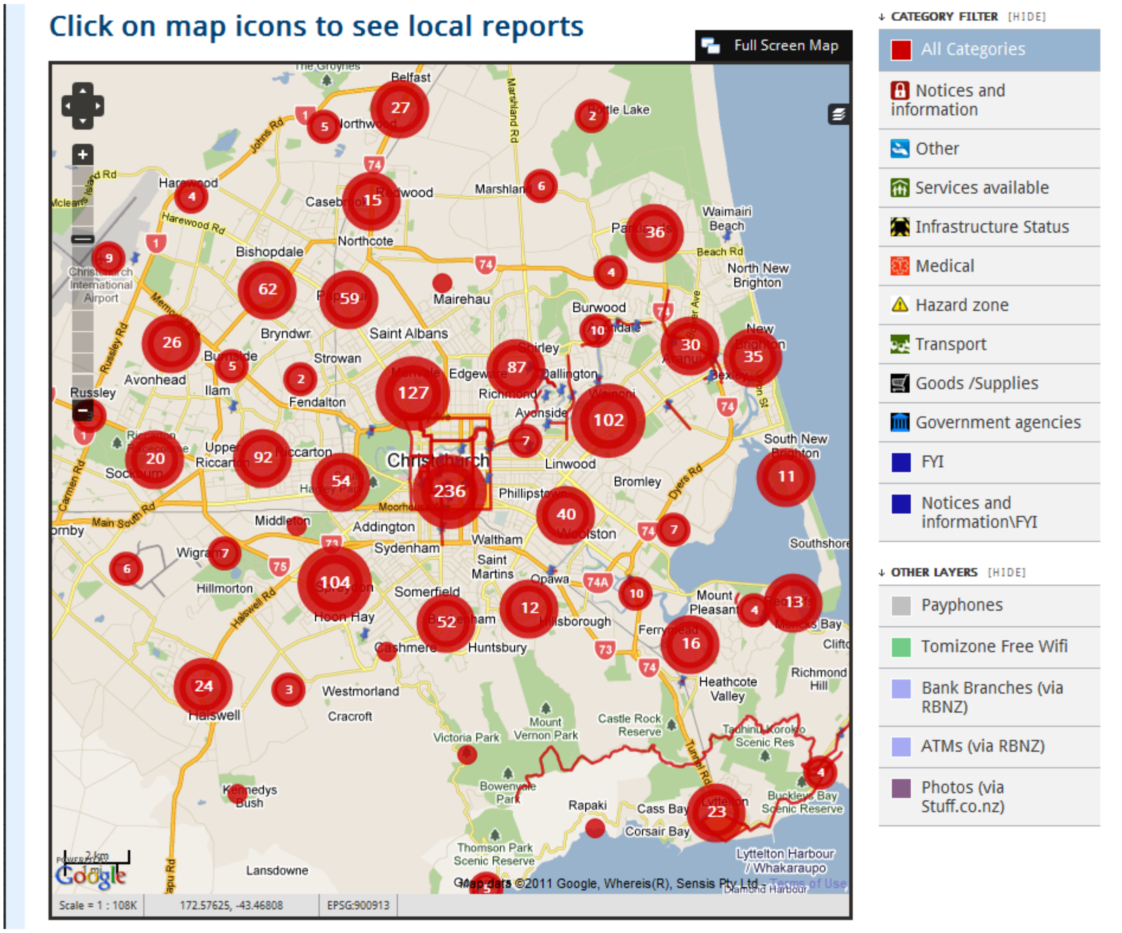


Figure 10 - Christchurch Infrastructure Ushahidi Site

7.5 NC4 E Team

7.5.1 In order for decision makers to know what is going on during an emergency there is a need to have accurate information pooled, sorted and available in order to achieve situational awareness and plan appropriate responses. The emergency management information service (EMIS) program is designed to provide a system that facilities situational awareness. EMIS allows participating organizations to share real-time emergency management information and data, including maps. At the centre of the BC EMIS strategy is the E Team secure web application.

7.5.2 The E Team system is used to store critical information such as Situation Reports, Resource Requests and Incidents, all available for mass consumption by each user group during an emergency. E Team enables each of the four pillars in EMBC– Planning, Logistics, Finance & Admin, and Operations, to gather information, approve resource requests, report information and to pass mission critical data from one organizational group to another.

7.5.3 EMBC has also used E Team web services interface that allows incidents to be pulled from the system and presented in EMBC's common operating picture "BCeMap".

7.5.4 Figure 11 shows an incident list in E Team.

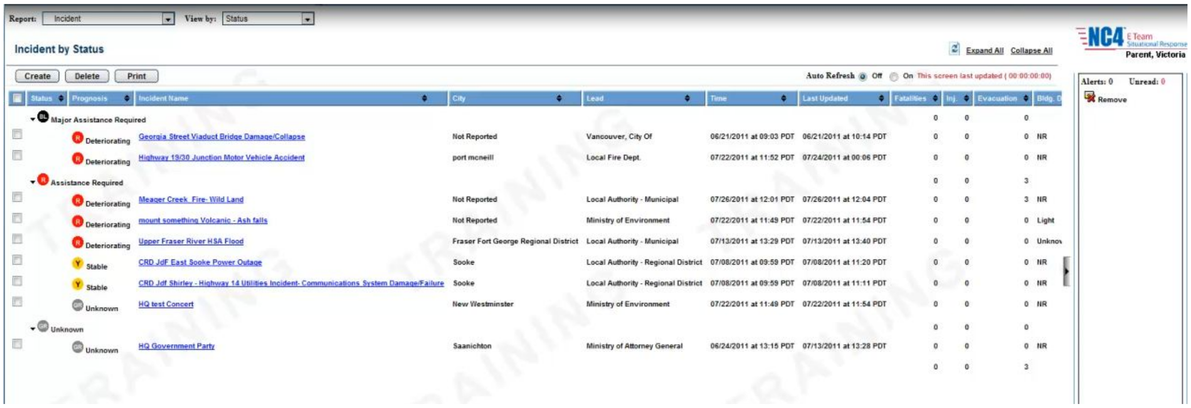


Figure 11 - Incident list in E Team

7.5.5 Other Reports that EMBC utilizes:

- Incident and Emergency Event reporting
- Resources and Critical Assets management
- Planned Events and Activities reporting
- Full Mapping and Overlay capability with Universal Console
- WSDL Web Services support
- Agency Situation reporting for situation reports
- Call Center reporting

7.6 EmerGeo Fusionpoint

7.6.1 EmerGeo Solutions Inc. has been developing and implementing crisis management and situational awareness software and services to clients worldwide since 2002.

7.6.2 EmerGeo's flagship product, Fusionpoint, provides EOCs and field personnel with a web dashboard that integrates data from disparate systems such as 9-1-1 dispatch, Automatic Vehicle Locations systems, crisis management software, news feeds, CCTV cameras and GIS mapping; enhanced capabilities include publishing and consuming data via interoperable systems using WMS, KML and GeoRSS.

7.6.3 More recent capabilities include the ability to consume MASAS messages, although this feature was not released in time to be incorporated in this experiment.

7.6.4 Fusionpoint provides a configurable web-based and portable crisis management system with features such as incident logging and reporting, task management, resource management, mapping and hazard modeling, and automated alerting.

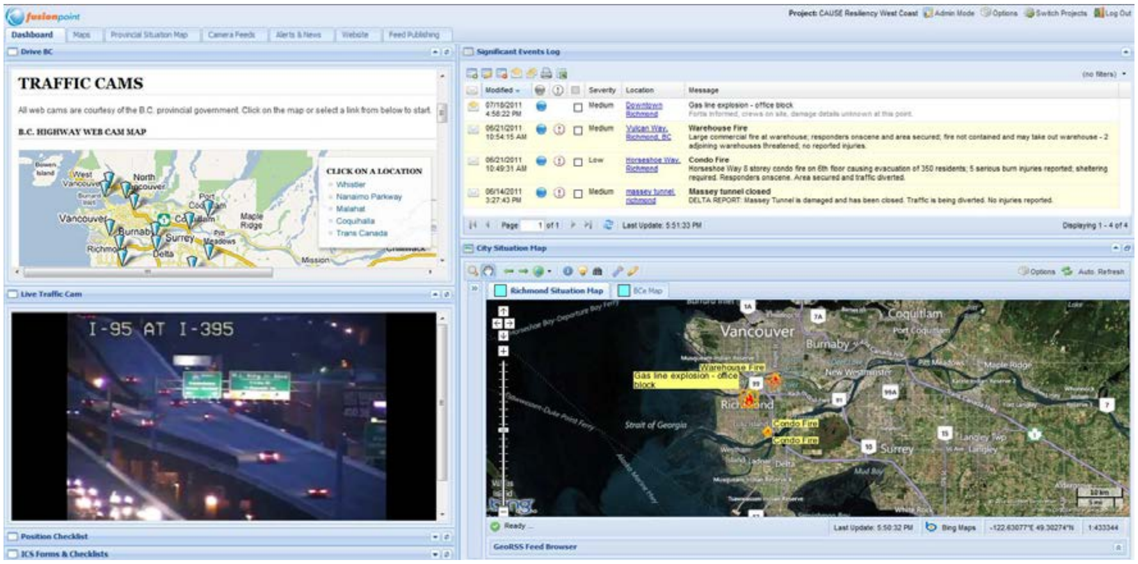


Figure 12 - EmerGeo Fusionpoint Dashboard

7.7 EmerGeo Smart Client

7.7.1 EmerGeo Smart Client is part of the EmerGeo Fusionpoint suite that manages, authors and publishes information to other web or thick client (mobile) users and provides advanced mapping capabilities such as hazard modeling and impact analysis. EmerGeo's web and mobile mapping solutions provide a common operating picture that uses the Open GIS Consortium's open interoperability framework to reach across the internet and intranets to invoke processing services and retrieve data from other GIS applications. The system can also be configured to publish data in real-time to third-party applications via WMS, KML, and GeoRSS.

7.7.2 For this experiment, the earthquake shake model was run to estimate damage in the region. See the example output below from the 9th September 2011 earthquake off Vancouver Island.

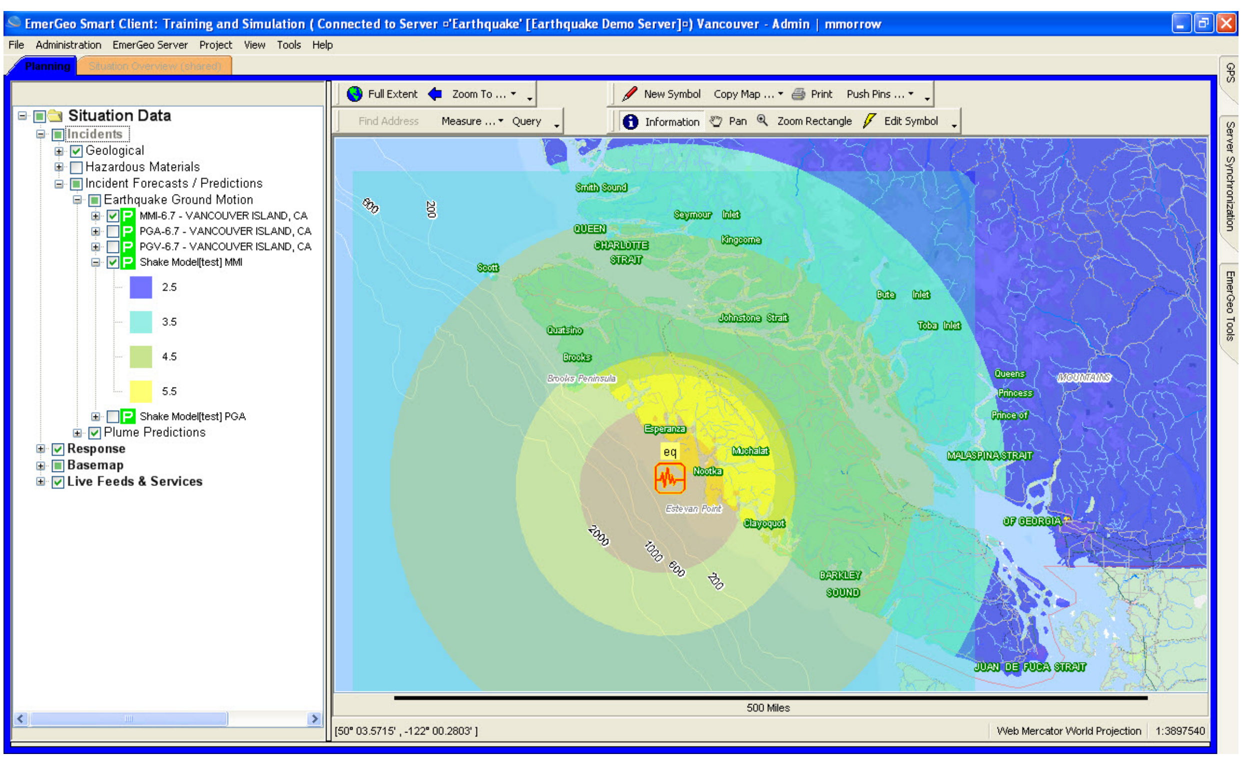


Figure 13 - EmerGeo Smart Client – shake model output from the recent 6.4 earthquake

I. Instrumental	Generally not felt by people unless in favorable conditions.
II. Weak	Felt only by a few people at best, especially on the upper floors of buildings. Delicately suspended objects may swing.
III. Slight	Felt quite noticeably by people indoors, especially on the upper floors of buildings. Many do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV. Moderate	Felt indoors by many people, outdoors by few people during the day. At night, some awaken. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rock noticeably. Dishes and windows rattle alarmingly.
V. Rather Strong	Felt outside by most, may not be felt by some outside in non-favorable conditions. Dishes and windows may break and large bells will ring. Vibrations like large train passing close to house.
VI. Strong	Felt by all; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books fall off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight.
VII. Very Strong	Difficult to stand; furniture broken; damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by people driving motor cars.
VIII. Destructive	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture moved.

Figure 14 - Modified Mercalli Index

7.8 The CAP/Atom Scenario Generator

7.8.1 The CAP/Atom message generator tool is a desktop application that was built specifically for the experiment in C#/.net using a SQLLite database. SQLLite is a public domain, self-contained library that provides a “zero-configuration” transactional SQL database engine. The .Net code runs on the .Net V4 library and provides the user interface which is shown in Figure 15. This interface allows a user to generate Common Alerting Protocol - Canadian Profile (CAP-CP) messages and/or Atom-only messages. Atom messages are used for sending messages that are more for general interest and were not used in the experiment. All messages generated were in the CAP-CP format and were published to a MASAS hub that was set up specifically for the project at http://cause.masas.ca

7.8.2 One of the outputs and leave-behind for the project was the code base developed for this product, including user and technical documentation. This product has already been put to use by EMBC for testing and training purposes on BCeMap and also to drive scenarios for *Operation Nanook* (a military exercise with greater than 500 personnel being deployed in Resolute, NU).

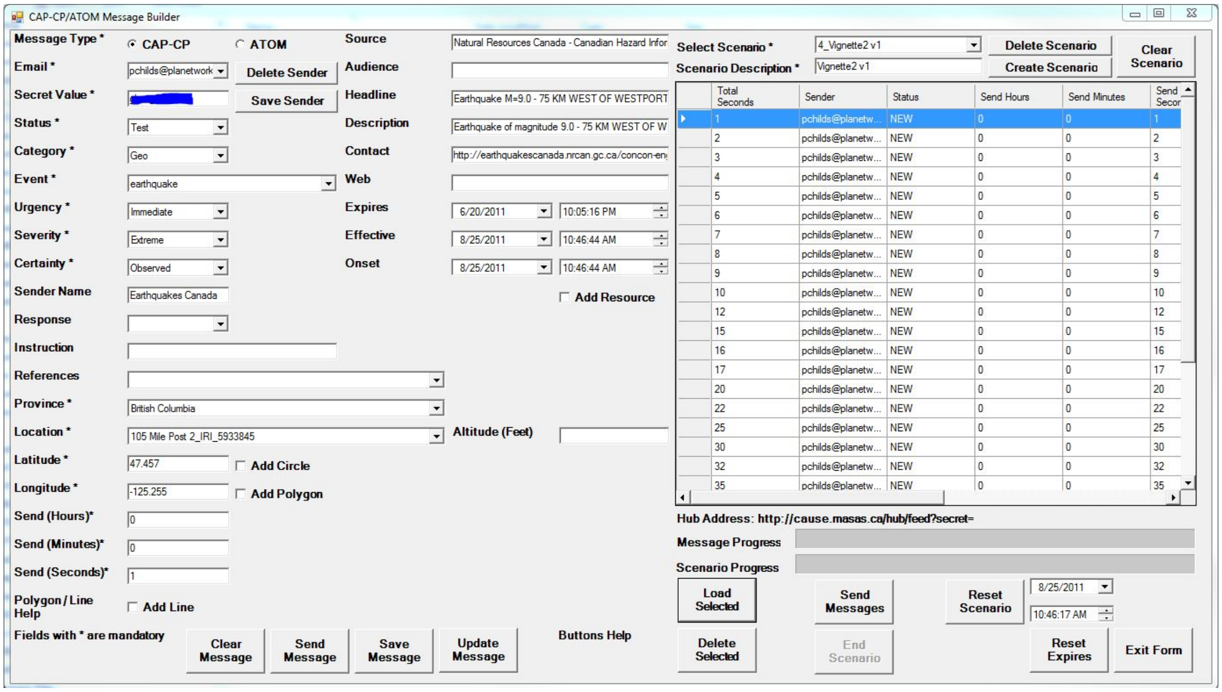


Figure 15 - CAP/Atom Scenario Generator

7.9 MASAS and CAP-CP

7.9.1 The national MASAS initiative has established an approach and technical solution for sharing authoritative, location-based situational awareness information. The purpose is near real time exchange, within Canada's emergency management community, and across the border with American colleagues.

7.9.2 MASAS adopts a system of systems approach – connecting many disparate systems using an open geospatial standard (ATOM), and using a Canadian version of the Common Alerting Protocol (CAP), and OASIS standard. The Canadian version is essentially a defined usage profile for the standard CAP messaging structure i.e. mapping of certain attributes to defined look up lists for event types and geographic areas that are specific to Canada. This is called the CAP–Canadian Profile, or CAP-CP.

7.9.3 The MASAS NIT have provided open source code to developers, to lower the barriers to adoption and interoperability, and allow message generation and consumption code to be incorporated in other systems.

7.9.4 For emergency management officials without their own application infrastructure, MASAS offers basic web hosted tools for posting and sharing their information and alerts.

7.9.5 The MASAS NIT, funded and guided by the national GeoConnections Program in concert with the CSS, continues its' efforts to build an enduring national capability, in alignment with the Communications Interoperability Strategy and Action Plan for Canada [2].

7.9.6 Development and operationalization funding for MASAS has been secured until 2013 via CSS and NRCan, with support and collaboration from Public Safety Canada.

7.9.7 Uptake of MASAS and CAP-CP is accelerating. MASAS has seen limited use in real emergency operations (e.g. to support Manitoba floods). Core infrastructure and supporting tools have been developed, tested, piloted and used in real operations.

7.9.8 Options analysis is underway for the development of an operational business model and components that will be fed into a broader policy development cycle for consideration by the federal partners and our Federal Provincial and Territorial partners via Senior Officials Responsible for Emergency Management (SOREM). Federal government is expected to continue to have a strong role in leadership on MASAS, but the day-to-day operating model is still under development.

7.9.9 MASAS is currently designed for emergency management officials only. No public access is currently provided,

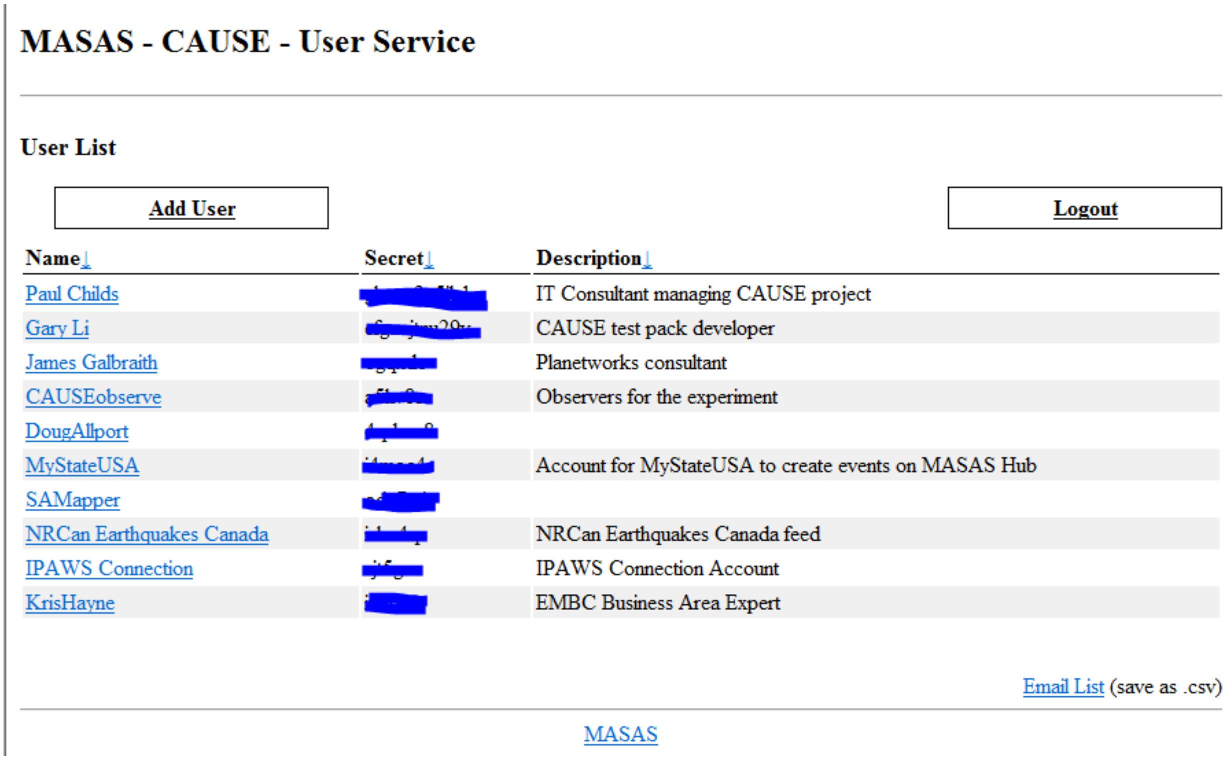
[2] http://www.publicsafety.gc.ca/prg/em/cisapc-scicpa-eng.aspx

but publicly-sourced 'open' data feeds and common operational datasets can be brought in provided they are trusted authoritative sources (BC River Forecast is an example). In addition the longer term future of MASAS may include interfaces with public alerting infrastructure (e.g. interoperation with e National Alert Aggregation and Dissemination.

7.10 The MASAS CAUSE Hub and Related Tools

7.10.1 A MASAS hub was set up and hosted at Simon Fraser University (SFU) specifically for the purpose of supporting the experiment at http://cause.masas.ca (Note that as this is a temporary site and no sensitive information was used in the experiment; a Secure Sockets Layer (SSL) certificate was not used (i.e. it was not an https site)).

7.10.2 **User Administration:** The MASAS hub tool set comes with a simple on-line access management tool that generates the 'secret' text string used to grant access. It is appreciated that this is not the long term security model, however it is currently easy to administer, and combined with SSL encryption, effectively secures the hub.



MASAS - CAUSE - User Service

User List

Add User **Logout**

Name↓	Secret↓	Description↓
Paul Childs	[redacted]	IT Consultant managing CAUSE project
Gary Li	[redacted]	CAUSE test pack developer
James Galbraith	[redacted]	Planetworks consultant
CAUSEobserve	[redacted]	Observers for the experiment
DougAllport	[redacted]	
MyStateUSA	[redacted]	Account for MyStateUSA to create events on MASAS Hub
SAMapper	[redacted]	
NRCan Earthquakes Canada	[redacted]	NRCan Earthquakes Canada feed
IPAWS Connection	[redacted]	IPAWS Connection Account
KrisHayne	[redacted]	EMBC Business Area Expert

Email List (save as .csv)

MASAS

7.10.3 **Viewer Tool -** The MASAS viewer tool allows users to view alerts that are active on the hub, including the ability to zoom and pan using the map display to focus in on areas of interest, as well as providing some basic filtering capabilities. A sample of the viewer tool as used in the 2011 Manitoba flooding is shown in Figure 16.

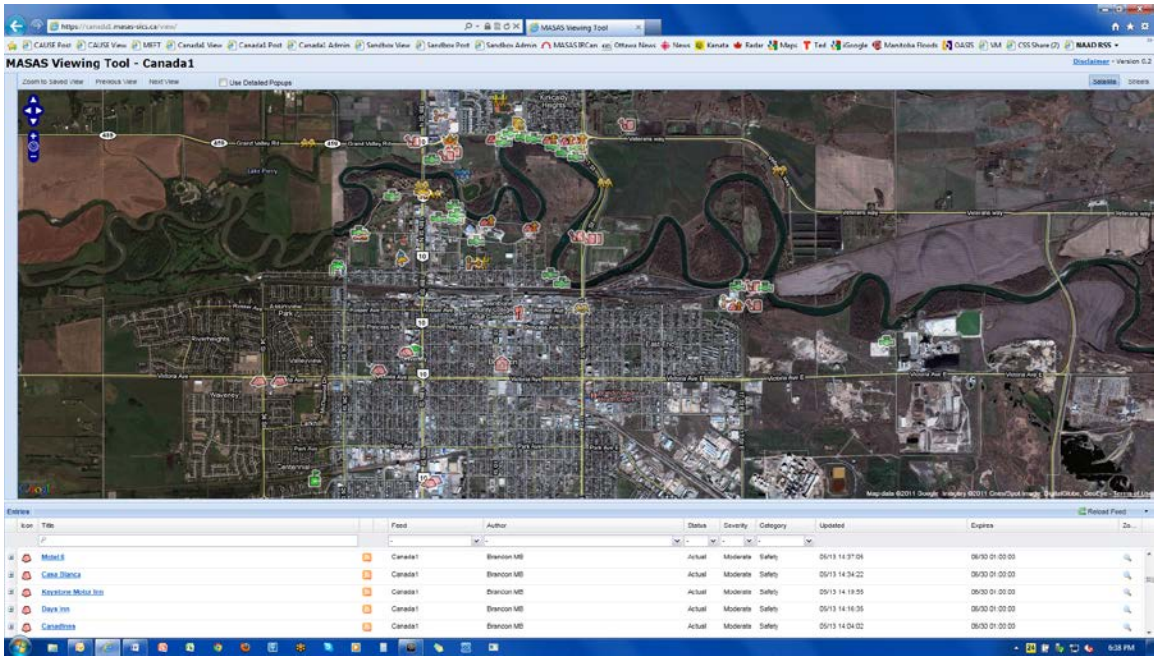


Figure 16 - Viewing Tool Example- Manitoba Flooding

7.10.4 **Posting tool -** the MASAS posting tool is an online interface that also allows CAP-CP and Atom Entry records to be created and updated. The scenario generator was used for most of the experiment to create messages in the experiment, however the online posting tool was used extensively to expire test messages and remove them effectively from the viewers connected to the hub prior to each experimental run (due to lack of update functionality in the message generator tool). See Figure 17.

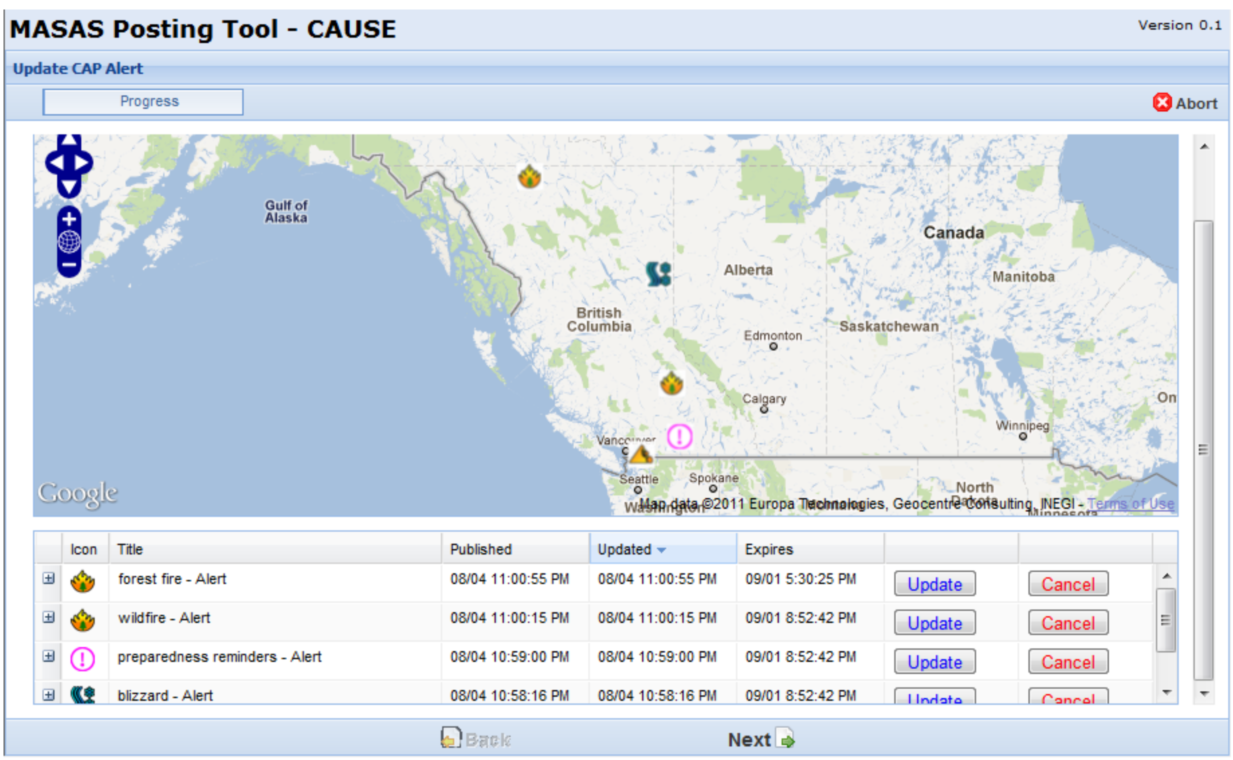


Figure 17 - MASAS Posting Tool

7.11 MASAS ESRI Flex Tools (MEFT)

7.11.1 Another viewing tool used in the experiment for observers was a demonstration version of the MASAS ESRI Flex

2.3 viewer, developed by the CSS and hosted by SFU at the following url: http://masas3.trl.sfu.ca/MEFT/

7.11.2 This site allowed observers to follow the “action” for each of the vignettes, but was used primarily for the briefing and regional overview sessions held in the morning on the dry run and execution date. See Figure 18.

7.11.3 The MEFT tools are available as open source code for use in any implementation of an ESRI Flex map presentation system, allowing MASAS events to be consumed (as used in this experiment) and published also.

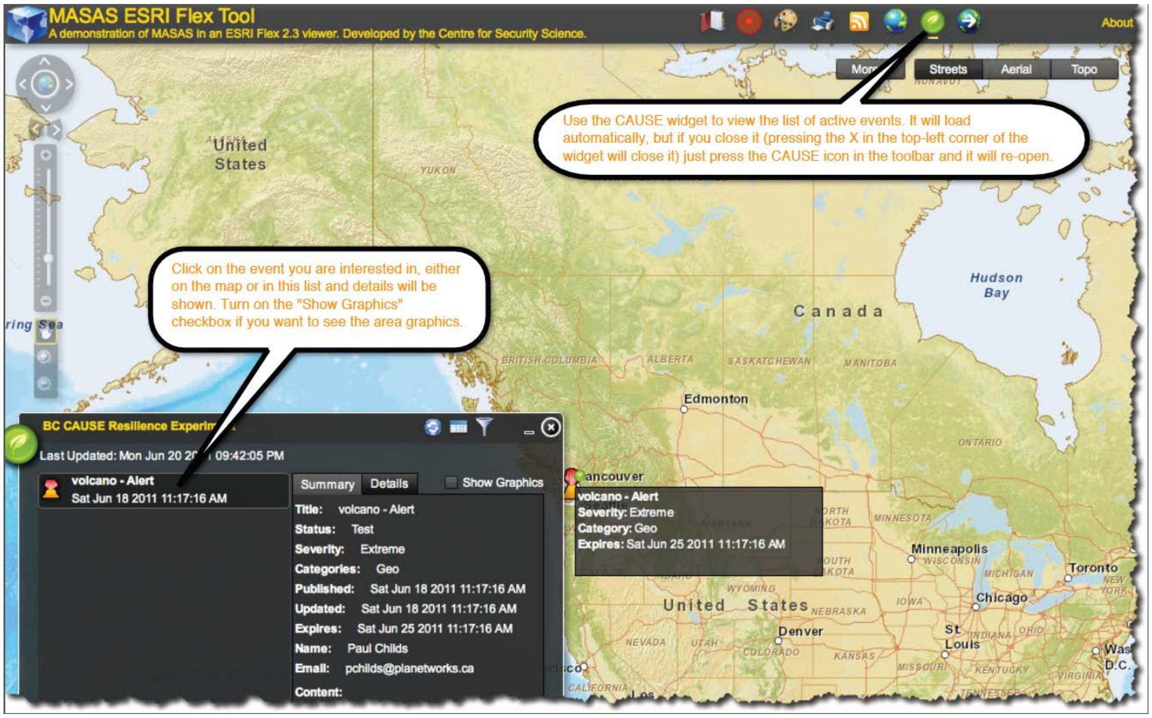


Figure 18 -MASAS ESRI Flex Tool (MEFT)

7.12 SAMapper

7.12.1 One of the systems implemented for the experiment by the PNNL team was a product called Situational Awareness Mapper (SAMapper). This was developed from a Graffiti tracking tool developed with police forces in mind for recording and tagging graffiti instances with the gang identifiers in a dashboard system. It was re-purposed and renamed for the experiment to allow mobile users to use a handheld PDA to take a picture of infrastructure damage and tag the record with the damage type and severity and for this to be pushed to the dashboard application hosted on Google Apps.

7.12.2 The hosted url was made available at http://samapper.appspot.com/SaMap.jsp, and did not require a login ID or password (i.e. account or role based security was not implemented).

7.12.3 A copy of the code for installing the mobile application was made available to the Canadian project and was installed and used during the experiment to demonstrate capture and coding of a picture, pushing the picture to the dashboard and subsequently to MASAS and BCeMap (to prove the international interconnection feasibility).

7.12.4 The dashboard presentation of the application is illustrated in Figure 19.

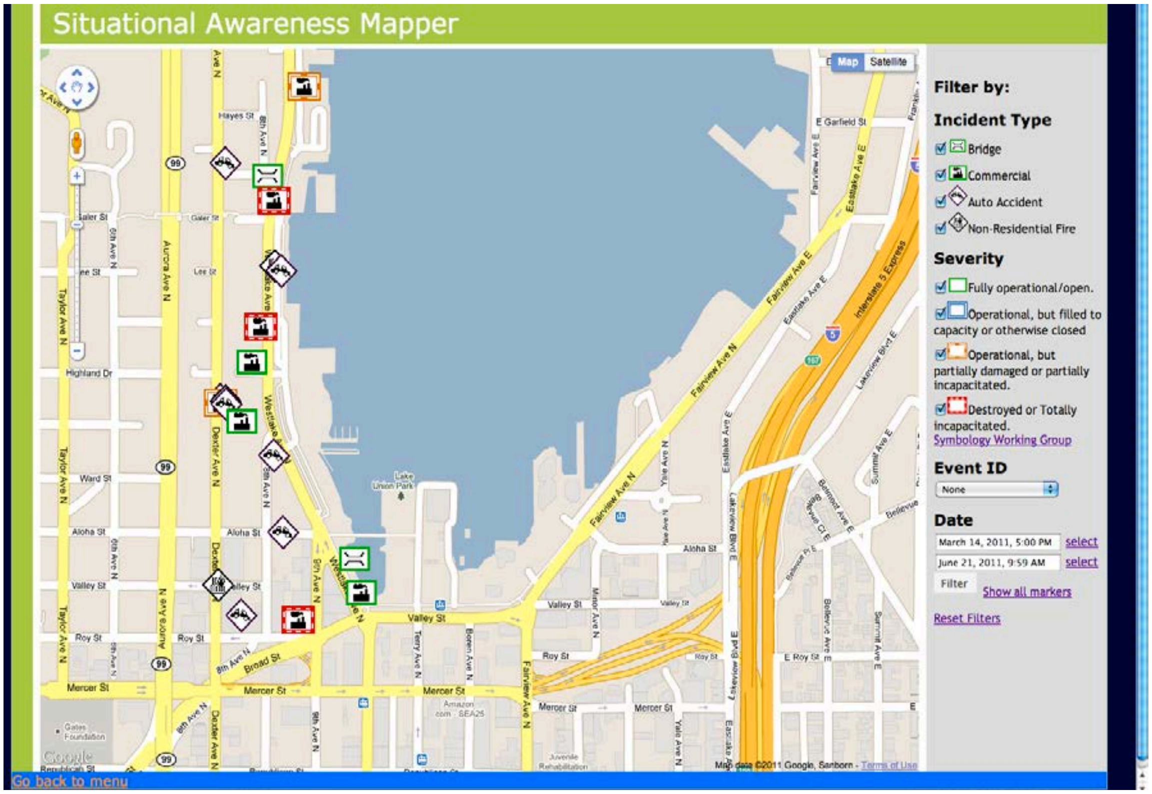


Figure 19 - SAMapper

7.13 MyStateUSA

7.13.1 MyStateUSA is a company that develops alerting products including CAP-compliant emergency alerting, public notification, content sharing and interoperability, focusing on community, campus, business and governmental agencies.

7.13.2 MyStateUSA is used by the Washington State Emergency Management Department for alert management and interoperation with DM Open and IPAWS. A screenshot from the MyStateUSA messaging console is included in Figure 20.

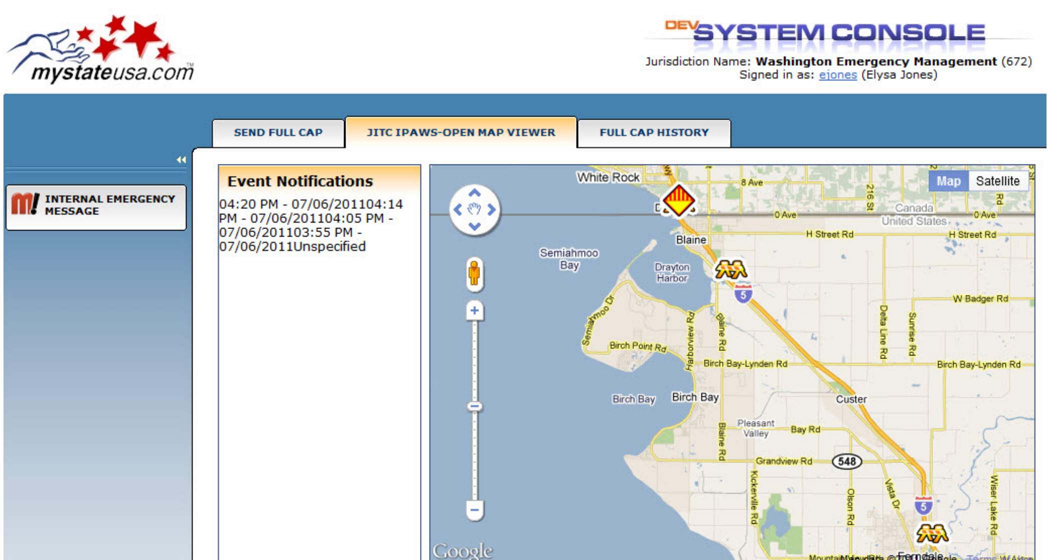


Figure 20 - MyStateUSA emergency message system console

7.14 IPAWS

7.14.1 In the United States, an executive order established the requirement for an "effective, reliable, integrated, flexible, and comprehensive system to alert and warn the American people". FEMA was designated within the Department of Homeland Security to implement policy and establish a program office to implement an Integrated Public Alert Warning System (IPAWS). More detail on the IPAWS program is available via http://www.fema.gov/emergency/ipaws/.

7.14.2 The IPAWS Open Platform for Emergency Networks (OPEN) consists of a set of securely hosted Web services that enable the routing of standards-compliant emergency messages between third-party applications, systems, networks and devices. Since the initial version of OPEN (DM-OPEN 1.0) had an established capability to route CAP alerts between organizations and to the public via the National Weather Service's (NWS) All-Hazards Emergency Message Collection System (HazCollect), OPEN was selected by FEMA to perform message aggregation for IPAWS.

7.14.3 The diagram in Figure 21[3] has at its core a message router, OPEN, which routes alerting messages between alerting authorities (similar to MASAS but using a more specific addressing scheme) and also to the public through the public alerting systems (a role that is not currently fulfilled by MASAS).

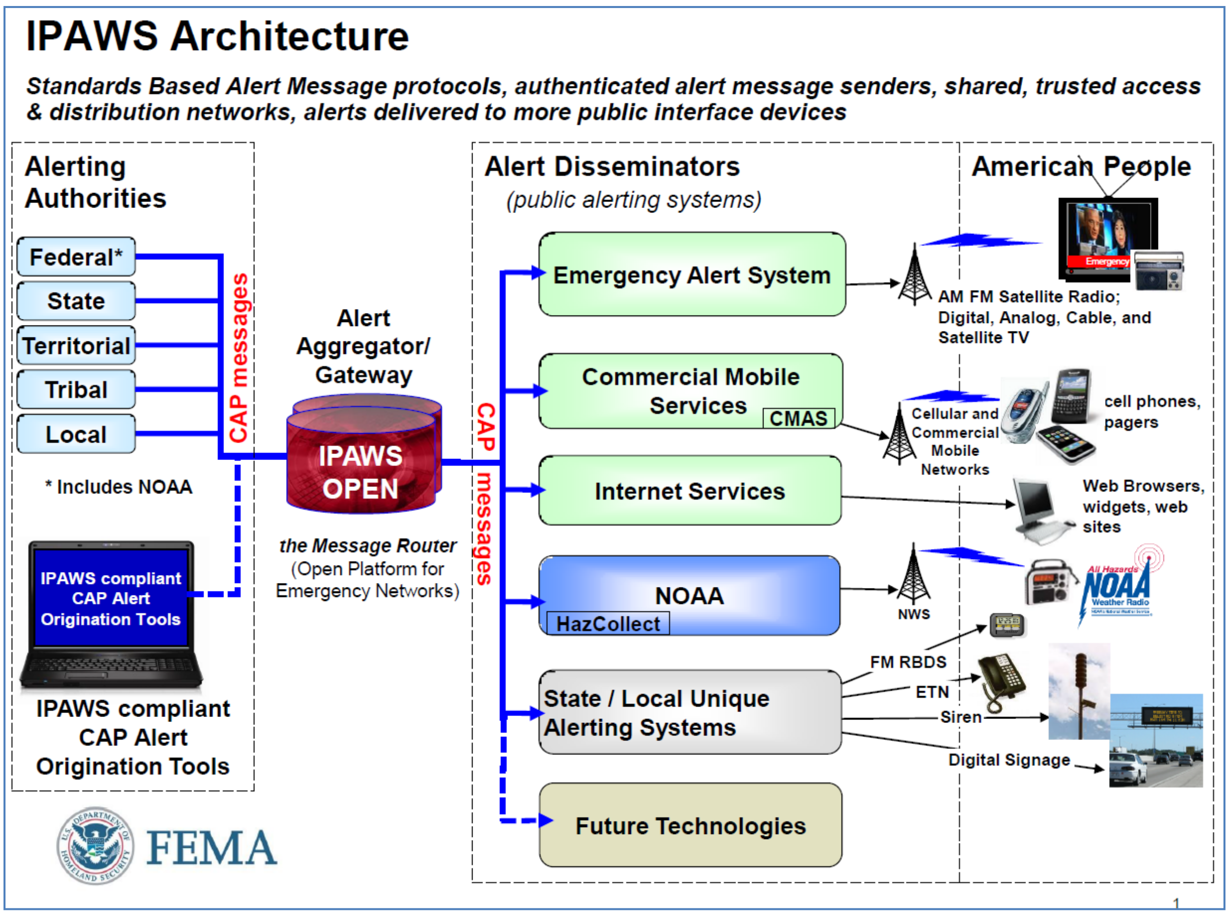


Figure 21 - IPAWS Architecture

7.14.4 IPAWS-OPEN enables the interoperable sharing of emergency alerts and incident-related data between systems that comply with non-proprietary information standards, and serves as the message aggregator for the Integrated Public Alert and Warning System. IPAWS-OPEN 2.0 supersedes the existing DM-OPEN which was scheduled for decommissioning by June 30, 2011.

[3] http://www.fema.gov/pdf/emergency/ipaws/architecture_diagram.pdf

7.14.5 Several private and public sector software developers have executed Memorandum of Agreements with FEMA in order to access the IPAWS-OPEN test environment. A listing is available in Adobe PDF format from http://www.fema.gov/pdf/emergency/ipaws/open_developers.pdf (this list includes MyStateUSA).

7.15 AMECom Truck

7.15.1 The SFU Advanced Mobile Emergency Communications (AMECom) project is intended to address the short term needs of many communities in BC that will potentially arise due to hazards that destroy local communication infrastructures.

7.15.2 The AMECom truck has been developed to meet this need and has an advanced set of communication capabilities. It can be quickly moved into place and activated to support local communities, provide voice and data services, provide communications for Emergency Operations and provide interoperation between disparate agencies radio systems.

7.15.3 The truck is a prototype and test bed for integrating different communication systems (from satellite, to microwave, and land mobile radio) and has already seen operation use at the request of the Provincial Emergency Management organisations.

Figure 22 - AMECom truck

8. Vignette1: The Story from Richmond Emergency Management – Before the Event

8.1 Vignette 1: Introduction

8.1.1 Emergency management personnel are constantly planning for all eventualities, except for those times when they are actively responding to real emergencies and incidents in their jurisdiction. An earthquake in the Cascadian subduction zone is an example of one such potential eventuality that is revisited periodically to refresh the understanding of characteristics of such an event, it's possible short and long term effects, and the operational response structures and procedures as these continue to develop and evolve.

8.1.2 Tools are becoming available that help with theses periodic assessments making the planners' jobs easier in terms of presenting tangible information on threats and potential damage.

8.1.3 This vignette is designed using models, developed for the City of Richmond, in a tool called Hazus-MH. The models, developed to be specific to the municipality, are used to help understand the threat and level of damage that may result from such an earthquake. The work to develop such models was performed in partnership with Natural Resources Canada (NRCan), which is developing an integrated risk assessment methodology for Canada as well as piloting the employment of Hazus-MH in various communities in BC. NRCan is also developing baseline data sets for broader areas such as Metro Vancouver (which encompasses multiple municipalities, including Richmond).

8.1.4 The models' output includes various damage assessments, such as loss of buildings, damage to critical infrastructure, loss of life, injuries and debris produced.

8.1.5 In this vignette, NRCan and City of Richmond staff work together to run scenarios, generating several damage assessment reports and discussing these with the seismic specialist at EMBC in order to determine whether the models are valid, consistent with accepted/standard methodology and whether they can be lodged for planning purposes in a provincial library. Such a library does not currently exist but might host the output of a number of threats, hazards and damage assessment, for various municipalities, for presentation through a tool such as BCeMap.

8.1.6 The vignette therefore also explores a means of storing the damage assessment outputs as static layers in BCeMap to be used in a later vignette.

8.2 Vignette 1: The Technology Integrations

8.2.1 For this vignette the Hazus-MH tool was furnished and supported by an NRCan project, managed by the Geological Survey of Canada, Earth Sciences Sector. This project is described in more detail in section 6.3

8.2.2 The data sources and flows that were used to support this vignette are illustrated in Figure 23. The Building Inventory and the Richmond specific sources are greyed out as these were not enabled in the experiment; however if available they could be used to augment the information coming from the other sources and would provide greater accuracy and detail in the damage assessments.

8.2.3 The NRCan project has developed a source database called the Asset Inventory Management System (AIMS), which is pre-populated by information from Statistics Canada (e.g. population and demographics), The Provincial Terrain Resources Inventory Mapping (TRIM) data, which includes water features, roads, point data such as bridges, tunnels and some point assets, GeoBC[4] municipal data (some asset information collected by GeoBC for emergency management purposes) and BC Assessment data (containing building location, value and usage information).

8.2.4 These inputs were used in the vignette to generate some basic outputs (called Hazus Level 1 outputs) as a starting point to allow the City of Richmond Emergency Management team to appreciate the capability.

[4] Subsequent to this project GeoBC has been restructured into a number of different ministries including Citizens Services. For the purposes of this report the term GeoBC continues to be used.

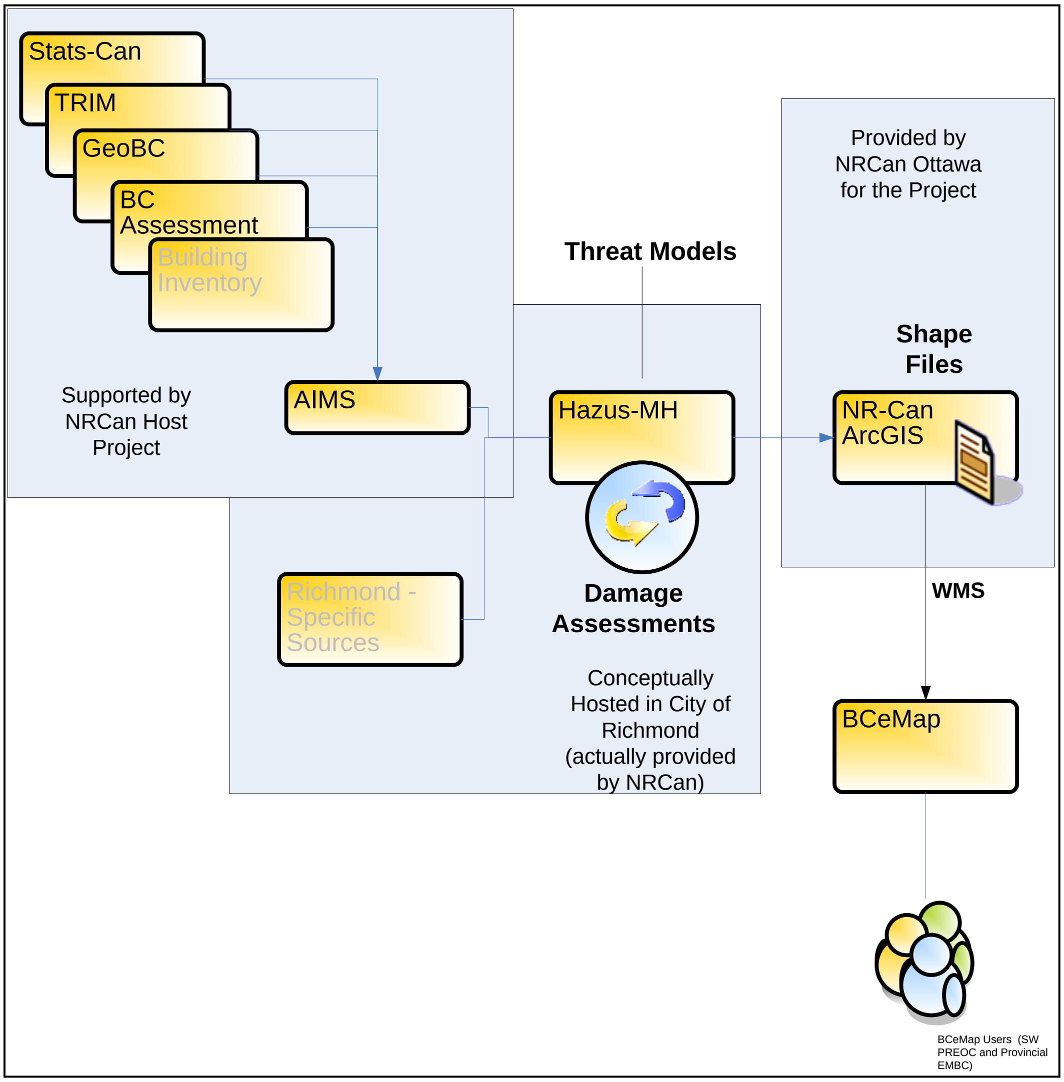


Figure 23 - Hazus-MH integration

8.2.5 Given the time available for the project, it was not possible to add any Richmond-specific asset data (e.g. critical infrastructure facilities), nor was it possible to clear the permissions required to obtain the building inventory data collected by UBC (which would provide a finer level of detail on the damage by block and census tract, i.e. Hazus Level 2).

8.2.6 However it was possible to run preliminary Level 1 damage assessments for the municipality with the following outputs:

- Total Debris in tons per Census Track
- Total Wood & Brick Debris in tons
- Total Concrete and Steel Debris in tons
- Number of Truckloads required based on calculation: Total Debris in tons per Census Track
- / 25 Tons per truck
- Total building damage loss per tract in Thousands of Dollars (does not include building content amount)

8.2.7 These damage assessments were produced in the context of the earthquake scenario used in this experiment, which is a threat model currently supported by parameters in the Hazus-MH system, based on the USGS scenario referenced in section 5.6.

8.2.8 Hazus-MH can produce numerous other outputs including projected injuries and deaths, however considering the preliminary nature of these outputs (i.e. not validated) and the potential sensitivities in the city to such information, especially if used in the film output, these were avoided at this point.

8.2.9 The outputs were saved to shape files (.shp) and then sent to NRCan to be hosted on Mapserver5 servers in Ottawa to provide the WMS output for consumption in BCeMap. BCeMap was able to consume and present the WMS layers relatively easily (it required an hour's work to determine the mime-type and configure the layers on BCeMap).

8.3 Vignette 1: The Action

8.3.1 A normal office environment was simulated at the Richmond film location. The action and dialogue was carried out between the city emergency management staff and NRCan consultants, discussing the inputs to the model, the quality or state of the developed data, and the potential outputs. The outputs were also discussed with the Provincial Seismic Specialist. Conceptually, if all municipalities were to perform the same analysis, this information could be aggregated and it would be apparent where the most damage might occur, supporting the ability to prioritize the recovery process according to need. Some samples of the outputs are shown below.

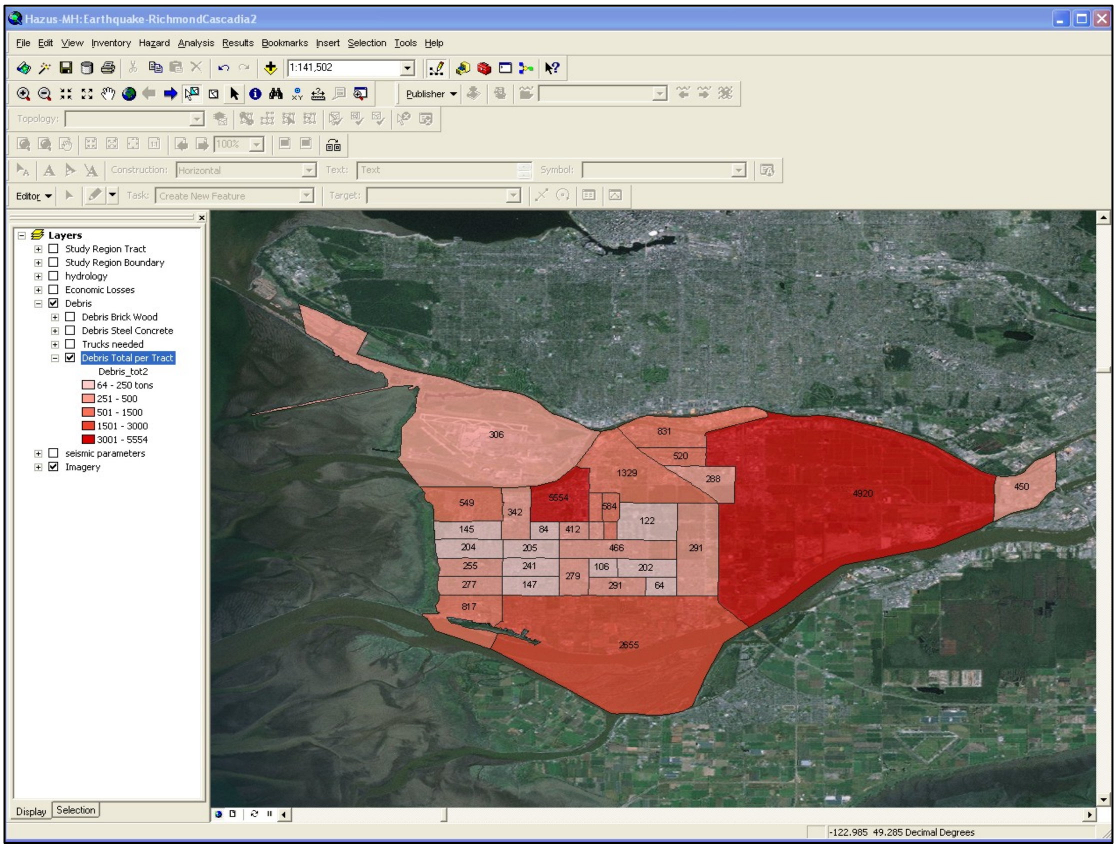


Figure 24 - Debris Total Per Tract

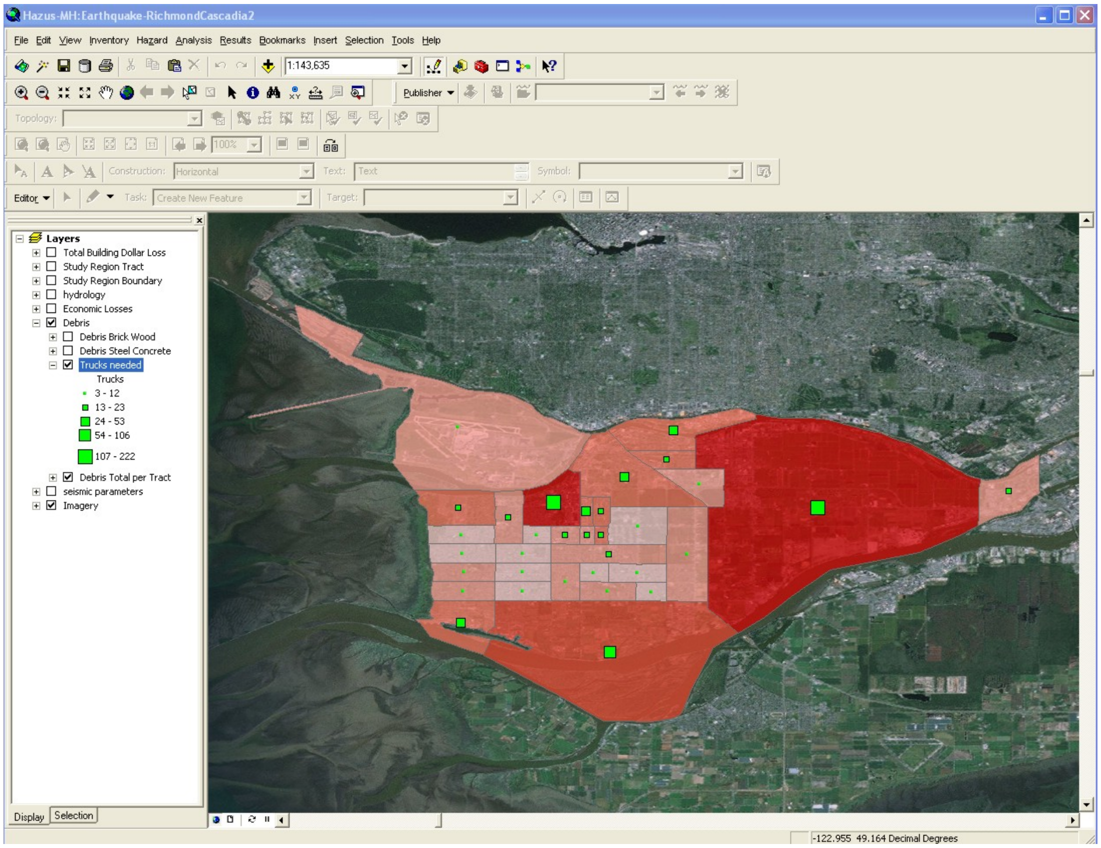


Figure 25 - Number of Truckloads Required

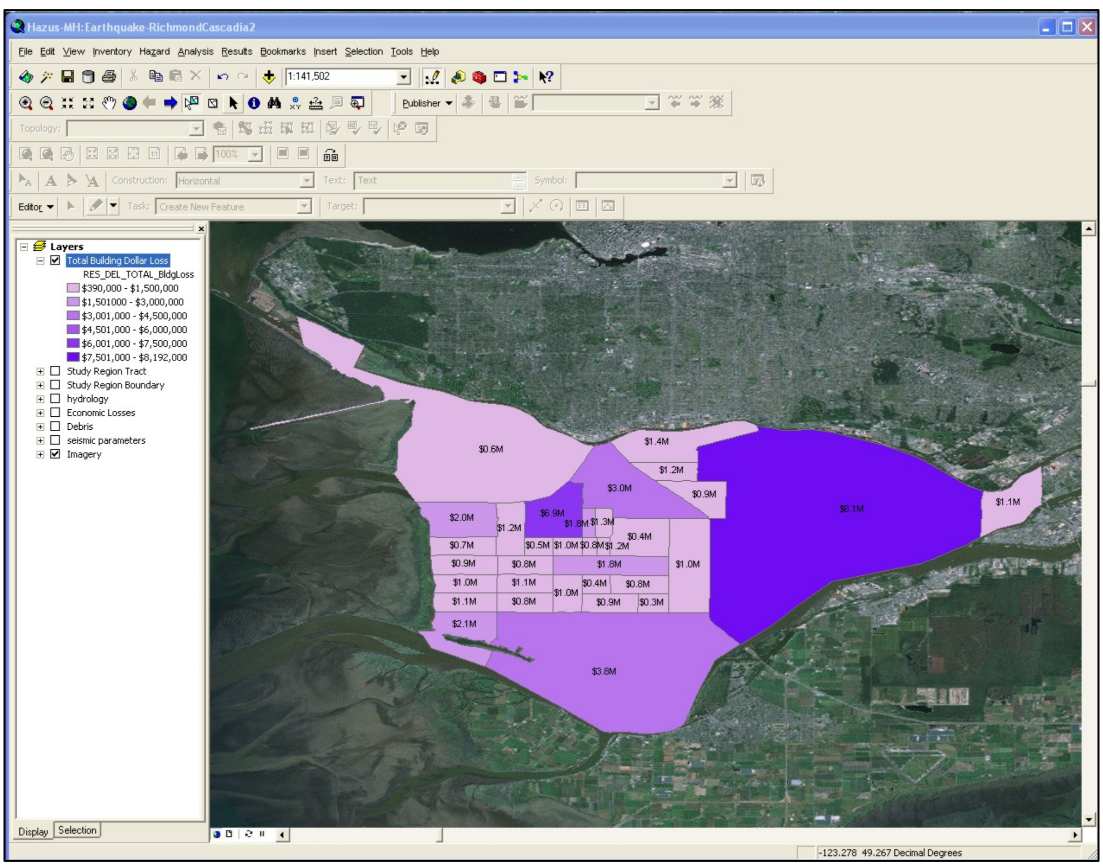


Figure 26 - Building Damage Loss

8.3.2 The outputs above would be available via printed or file outputs from the Hazus-MH tool, which would conceptually be hosted and managed in this context by the City of Richmond (in order to protect any city-specific critical infrastructure data that is entered into the system). The problem then becomes one of managing the file outputs from both a city and Provincial perspective, i.e. how are these files to be stored and archived by threat scenario and made readily available locally or provincially (with an ability to compare and contrast different municipalities)? One option is to register the output files as layers in BCeMap such that they can be turned on and off by threat, by damage type and by municipality. This was implemented for Richmond for the experiment as described above and illustrated below i.e. as layers in BCeMap.

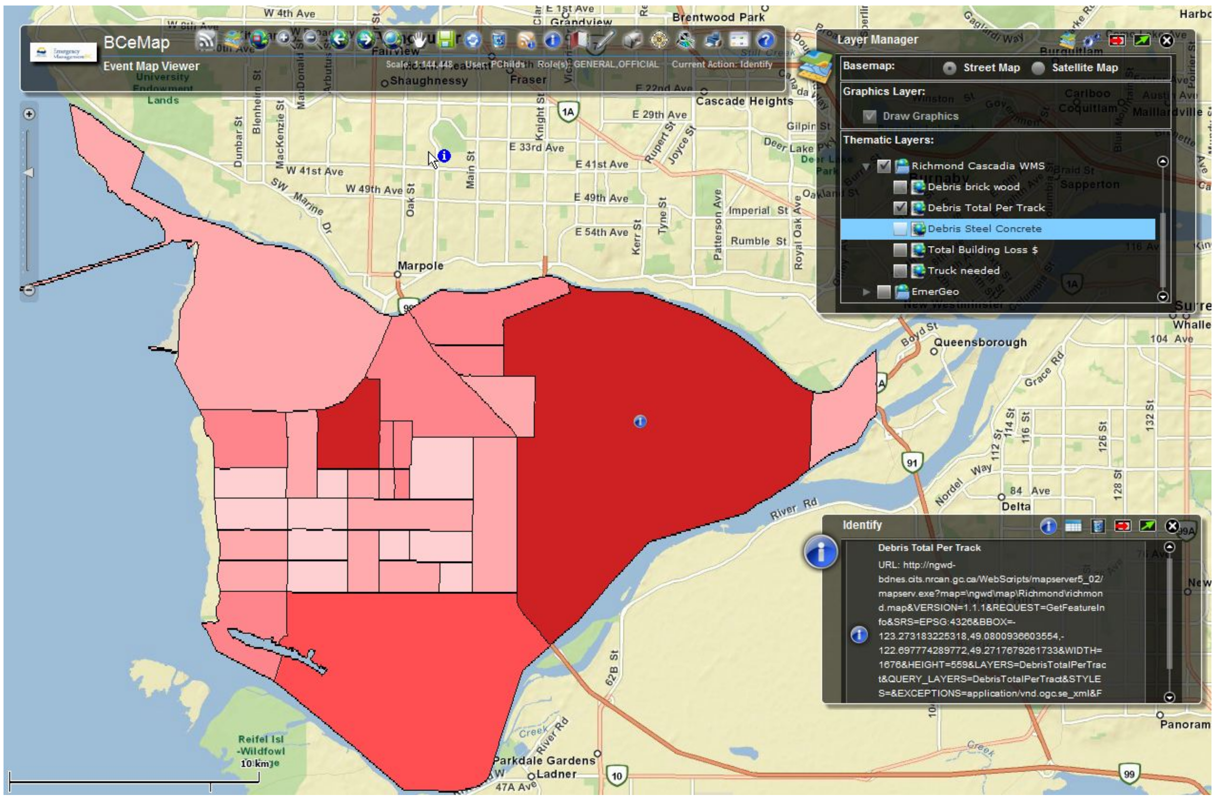


Figure 27 - Total Debris Per Tract

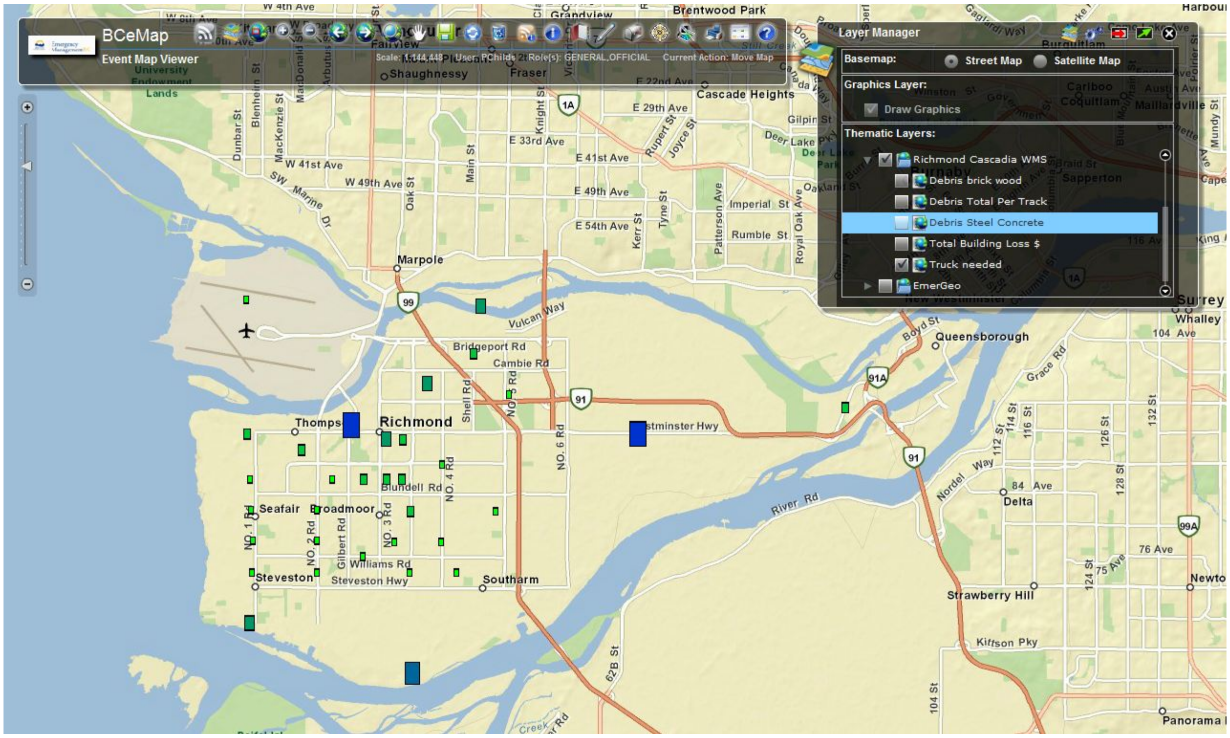


Figure 28 - Total Trucks Needed

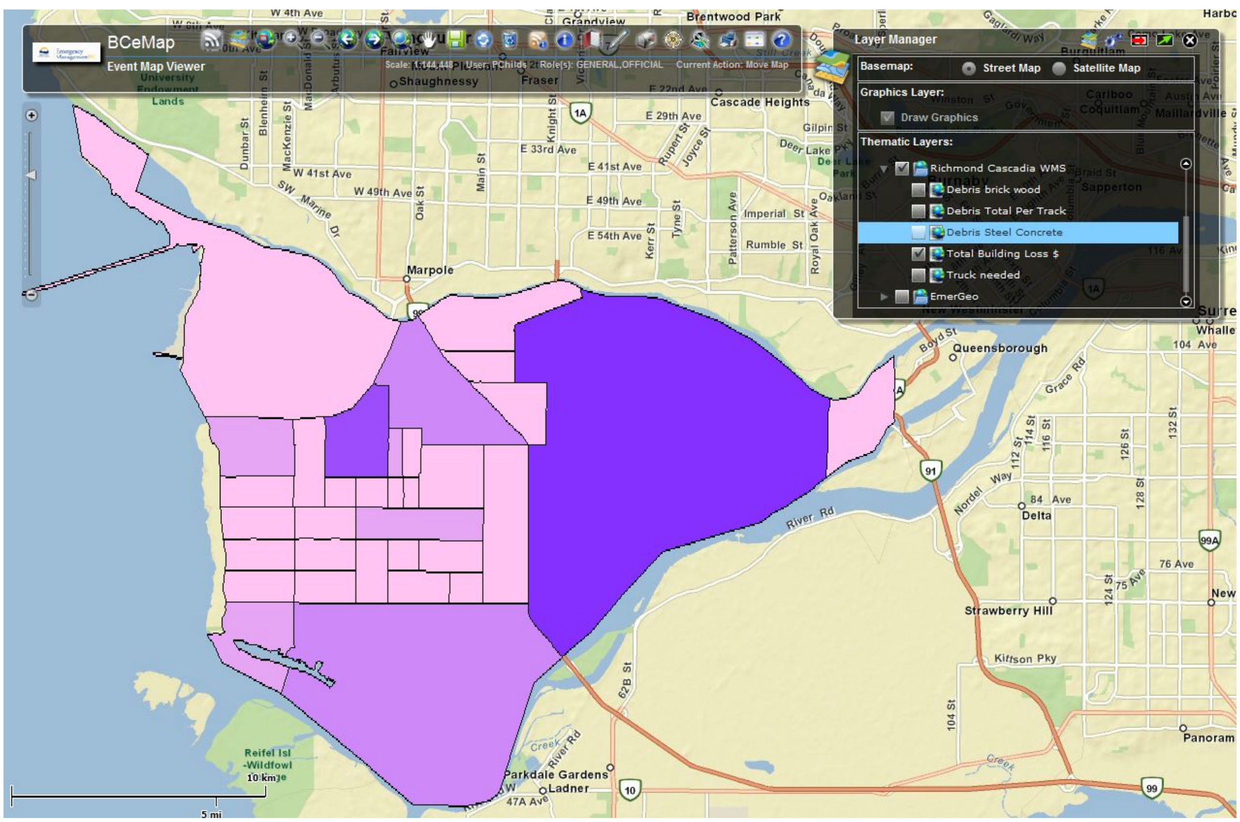


Figure 29 - Total Building Loss

8.4 Experimental Findings from the Vignette

8.4.1 In general, the Hazus-MH tool was well received and deemed useful by the City of Richmond Emergency Management team, contributing to the goal of being able to develop a better understanding of the potential effect of different scenarios.

8.4.2 It was felt that a fully developed model with trusted inputs could be valuable in modeling and planning for various scenarios. There are, however, concerns around the costs, in terms of time and effort, that could be incurred to develop and maintain an accurate database of inputs (including assets and critical infrastructure), as well as concerns as to how much faith could be placed in the output. One significant concern relates to the requirement to validate the science behind the soil type data chosen for the model, as this input would have a significant impact on the outputs, particularly for Richmond which is on a flood plain surrounded by dykes.

8.4.3 Whether Hazus-MH could be of benefit as a potential repository of Critical Infrastructure information was discussed i.e. consolidation in a single system as opposed to being maintained across a number of files as is currently the case. Presentation could be enabled in the Emergency Operations Centre through projection on a large screen with suitable user access to the software. There would; however, be limitations for multi-user access and for different users requirement (the need to see information at different times), as Hazus-MH was essentially designed as software for a single personal computer. It would therefore not easily support the concept of a virtual operations centre that is being considered by the City of Richmond. (An inherent requirement being provision of support for remote users having access to the information.)

8.4.4 Another concern expressed related to the potential for Hazus models to be used to determine the relative possible damage in each municipality, and to then employ those models to determine priorities and/or allocate resources at the provincial level. It was felt that this was a somewhat dangerous proposition and that its real value lies in supporting municipal assessments and requests for resources and state why they need it, and for decisions to be made on this basis rather than on theoretical models and computer generated information.

8.4.5 If or when BCeMap is rolled out to municipalities, it would be possible to enter Richmond-specific data layers into BCeMap which could be secured by the BCeMap security gateway so as to be only accessible to Richmond personnel. The information could be mastered locally e.g. in something like Hazus and then served up "in the cloud" through BCeMap, if that was deemed to be an appropriate mechanism (i.e. if the security concerns of having the information hosted outside of the Richmond jurisdiction infrastructure were overcome).

8.4.6 For the damage assessment layer output from Hazus-MH, as can be seen from the figures above, the presentation in BCeMap is very similar to that possible in Hazus. However the one item missing in the experimental implementation is the class descriptors for the various colours. In Figure 6 the WMS "identify" function has been used to show the data available from the Mapserv service, but this function is not viewed as being very useful. Further investigation will be needed to see if the WMS can deliver this information if determined to be required. The second potential limitation is the need for these files to be supported by the thematic layers menu hierarchy, which, though effective for even significant numbers of layers, may prove problematic if there are 20 or more damage layers per threat scenario, multiple threat scenarios (which may need to be indexed and referenced with descriptive data) and multiple municipalities hosted on the system. A simple menu hierarch may not be sufficient and a slightly more sophisticated user interface would need to be considered.

8.4.7 It is understood that NRCan is also pursuing projects to develop the potential presentation of Hazus outputs in more useable formats: namely though an adapter to an ArcGIS add-on tool called CommunityViz Scenario360[5], and also through a project through a contract placed with Galdos Systems Inc. to develop an online registry of Hazus model output layers. Neither of these projects was developed sufficiently to be included in the CAUSE experiment this year.

8.4.8 During the experiment it was discovered that Hazus-MH is only one of a set of tools in use by the USGS and FEMA in the United States for planning and provision of early warnings or models of Seismic events. There are also a number of tools that are dynamically linked to the automatic output of the USGS seismic sensors that could be used in the immediate aftermath of a major earthquake in advance of the use of Hazus-MH to provide detailed model outputs somewhat after the event.

8.4.9 The following skeleton timeline and list of tools was provided by NRCan as part of their investigations with US counterparts relating to their projects. The USGS real-time earthquake feed would trigger two outputs, the first is the pager output, which is essentially a broadcast information sheet on population impacts and includes Shakemaps.

[5] http://placeways.com/products/index.php

There is also a Shakecast application that can be implemented by any organization using free software. It allows a subset of the Hazus models to be run in real time off the USGS real-time feed and supports rapid impact assessments. There was insufficient time to evaluate or trial this application as part of the CAUSE experiment; however, these tools could work off the same baseline data sets at Hazus and would therefore be of incremental value on top of those data sets if implemented.

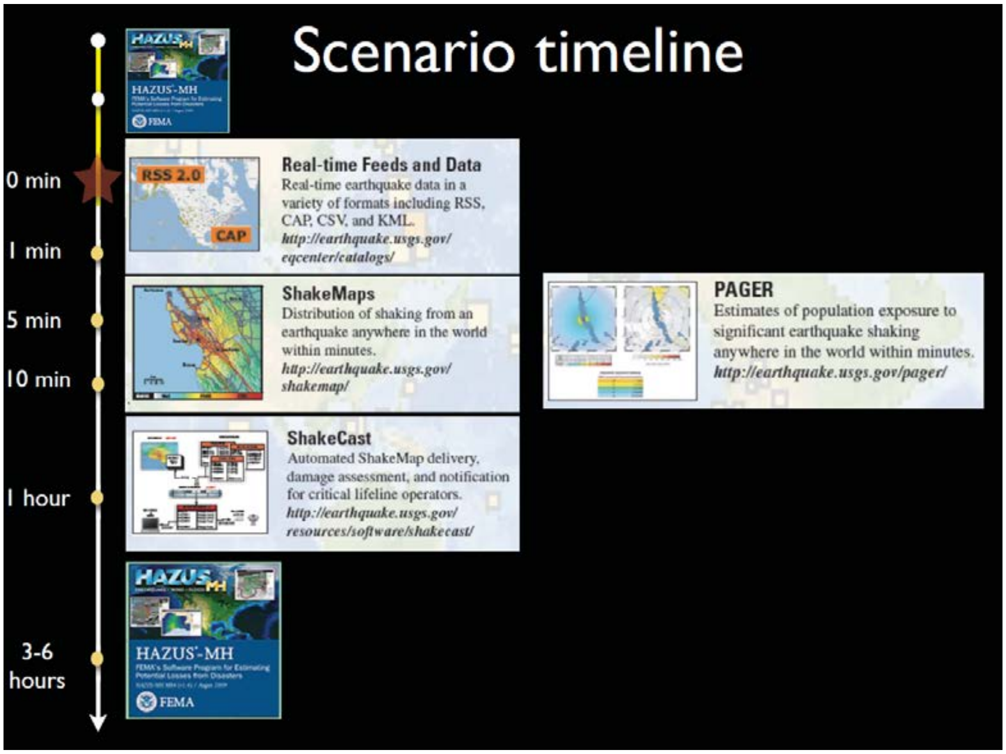


Figure 30 - Other Seismic Warning and Analysis Tools

8.5 Vignette Recommendations

8.5.1 Based on the findings above it is recommended that the City of Richmond investigate incorporation of Hazus-MH into their tool set for evaluating potential damage during various threat scenarios and storing the output for planning and analysis purposes. Follow-on work includes upgrading the soils data files, adding the building inventory data sets as produced by UBC and inputting Richmond-specific critical infrastructure data. This would place the city at the forefront of municipal hazard analysis in Canada, matched only by North Vancouver and Squamish (other participants in the NRCan pilot projects). However the resource required to build and maintain accurate models should not be underestimated.

8.5.2 Additional work is underway through the NRCan projects to develop the data sources for AIMS, including enhancing sources of data and providing the access mechanisms to the AIMS data for municipalities as the information is updated. As part of this a long term hosting/service solution is required for AIMS which may require provincial support.

8.5.3 Further investigation is required into defining requirements for an appropriate mechanism for storing the library of threats and related damage assessments output by each municipality, based on who would need access to these and for what purpose. Local decision makers and planners certainly need access, potentially remotely if the Virtual Emergency Operations Centre concept is in place, however there may be benefit in regional or provincial access. A further objective of future CAUSE experiments could explore the requirements and the alternatives further i.e. the requirements and outputs of the CommunityViz and Galdos projects

8.5.4 Since the Hazus modules use very similar data to that used by the USGS Shakecast tool which can provide a short term and high level assessment of damage in the case of a live event, it is recommended that Shakecast is evaluated to understand if additional benefit can be leveraged from the data collation undertaken for Hazus. This again could be part of a future experiment.

8.5.5 Development of a provincial framework, in partnership with NRCan for providing additional support to municipalities may also be required. This may take the form of:

- a framework for collaboration and pooling of resources if there is insufficient resource at a local level
- assistance with developing an understanding and expertise in science to allow trust in the outputs that are developed
- support for developing a range of threat scenarios that can be used by municipalities and tailored for local circumstances

9. Vignette 2: Richmond EOC Activation and Situation Assessment

9.1 Vignette 2: Introduction

9.1.1 This vignette is based on the activation of the City of Richmond EOC and the initial briefings as staff arrive using EmerGeo Fusionpoint as the incident management system and employing the EmerGeo Smart Client to assess the potential ground shake effects in Richmond as reports come in of damage to the city.

9.1.2 Fusionpoint was implemented as a hosted system so as to allow remote decision makers to access the software, and dialogue was enacted with remote users with the Fusionpoint incident records and maps as context for the discussions.

9.1.3 As the story unfolds of incidents in Richmond, the vignette develops to the point where a dialogue is conducted between Richmond EOC and the South West PREOC. This includes a briefing based on the incidents recorded in EmerGeo Fusionpoint and a representation of those incidents communicated to the SW PREOC through BCeMap. The discussion also covers the need for communications support at Richmond City hall due to intermittent internet connectivity which is limiting data communications and a request for the AMECom truck for this purpose. At the South West PREOC the damage assessment model output from Hazus-MH was also selected in conjunction with the provincial seismic expert.

9.1.4 In reality such communications between the City of Richmond and SWPREOC would be managed through situation reports and formal resource requests; however, the interaction was dramatized for purposes of illustration.

9.2 Vignette 2: The Technologies

9.2.1 The vignette involves use of EmerGeo Fusionpoint which is described in section 6.6. This was set up and hosted by EmerGeo for the purposes of the experiment. The main features of the product exercised were the links to traffic cameras, the incident capture screens and the map representation of the city.

9.2.2 Both Richmond EOC members and remote users were able to access the application remotely by means of a browser. More could have been made of this capability in the experiment, for example by engaging a decision maker in the process; however, the vignette limited utilization to acting out the possibility.

9.2.3 A WMS feed was set-up on the application to publish the incidents captured in the system for consumption in BCeMap to support the dialogue with the SW PREOC.

9.2.4 The EmerGeo Smart Client was fed by an alert that could have been published by USGS describing the location, magnitude and depth of the Earthquake. The simulated input for the vignette was pulled from a library of published USGS events.

9.2.5 Traffic cameras were also configured to be accessible to the users through the Fusionpoint portal for use in the experiment.

9.2.6 These configurations are illustrated in Figure 31.

9.2.7 The deployment of the AMECom truck and a tactical communications kit was discussed as part of the dialogue, and the deployment of the AMECom truck to Vancouver airport was simulated but not actually implemented as part of the project because of scheduling conflicts.

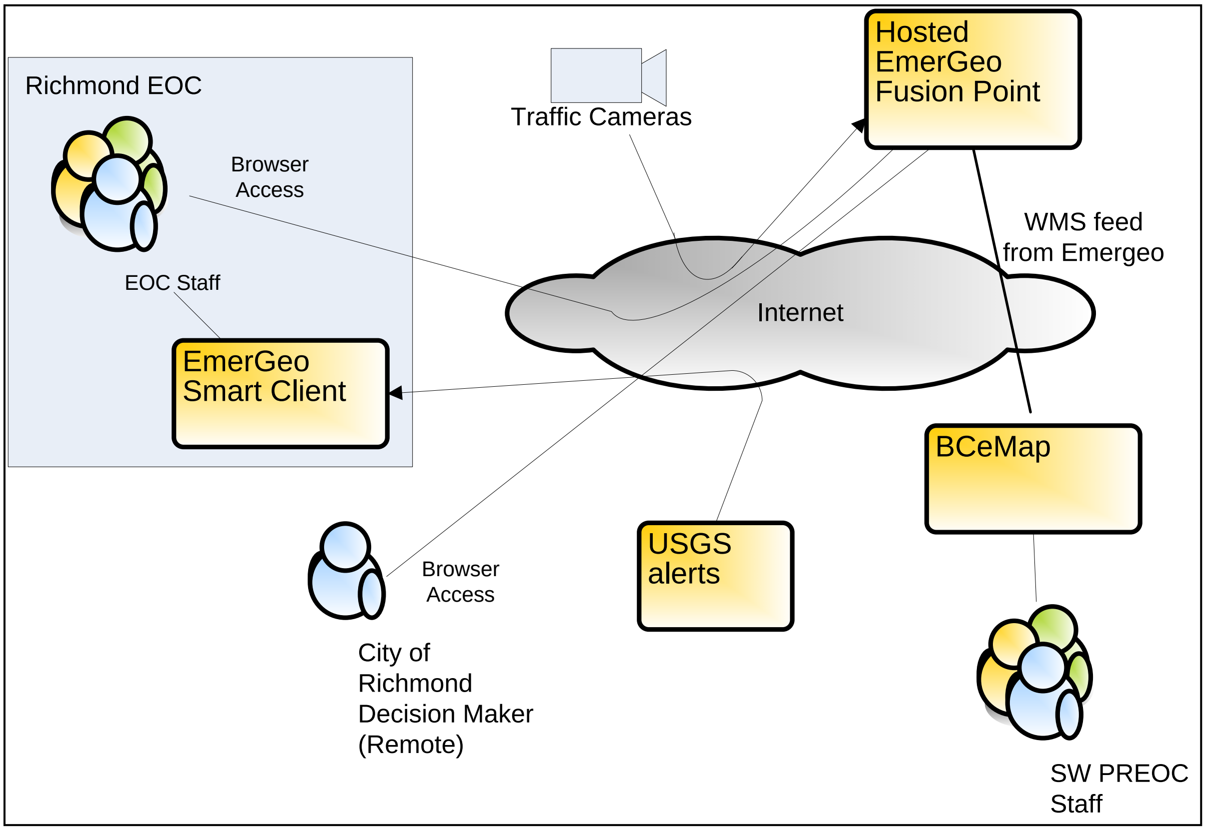


Figure 31 - EmerGeo Fusionpoint and Smart Client

9.3 Vignette 2: The Action

9.3.1 The vignette starts with the arrival of EOC staff and a general briefing from the Experiment Coordinator and the EOC Director to set the scene and describe incidents to date. This included a general information update regarding inputs from other systems and neighbouring jurisdictions and illustrations using the Message Generator, MASAS and BCeMap. This briefing included the earthquake location, magnitude and aftershocks, tsunami alerts, including one for the Strait of Georgia indicating wave heights at peak of 0.5 metres (not a concern to Richmond dykes); also seismic sensor readings and bridge sensors readings on the bridge structures including damage to the Annacis Channel Bridge and on-ramps, resultant congestion on the Alex Fraser bridge. Detail on these inputs is included in a later vignette (as they were not a focus for this one).

9.3.2 The EOC Director then hands over for a briefing from the EOC GIS expert.

9.3.3 The first local incident reported is the closure of the Massey Tunnel (input from the municipality of Delta) due to liquefaction and confirmed via the ability to see camera images of the congestion as a result (see Figure 32). The incident details were presented as in Figure 33. These screenshots are taken from EmerGeo Fusionpoint.

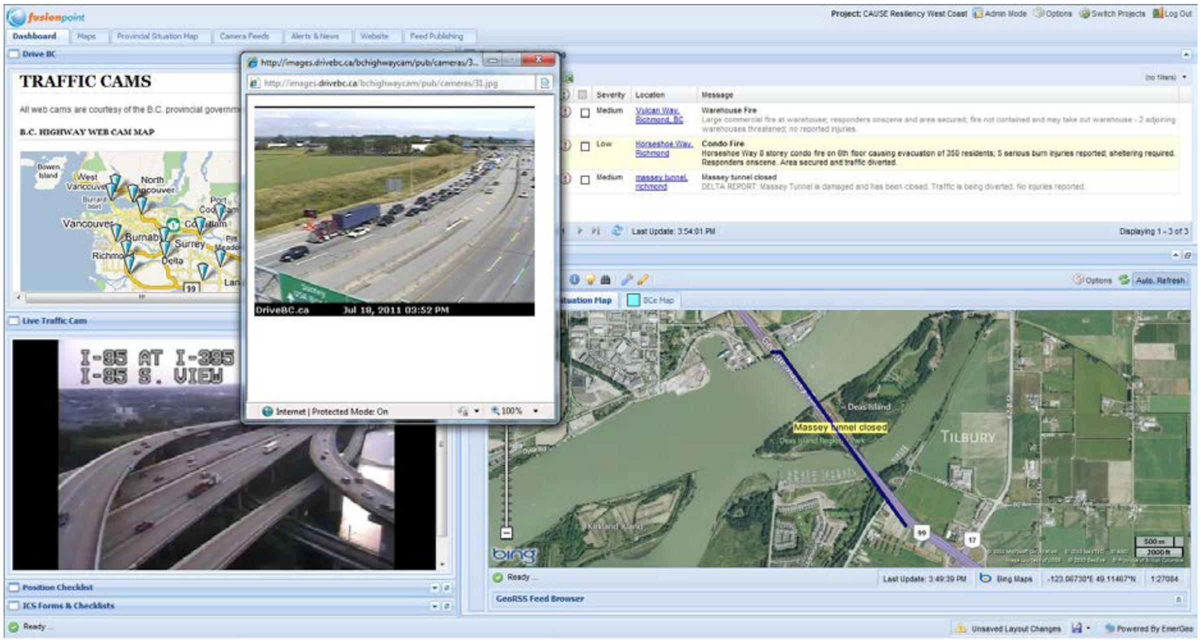


Figure 32 - Massey Tunney Traffic Cameras

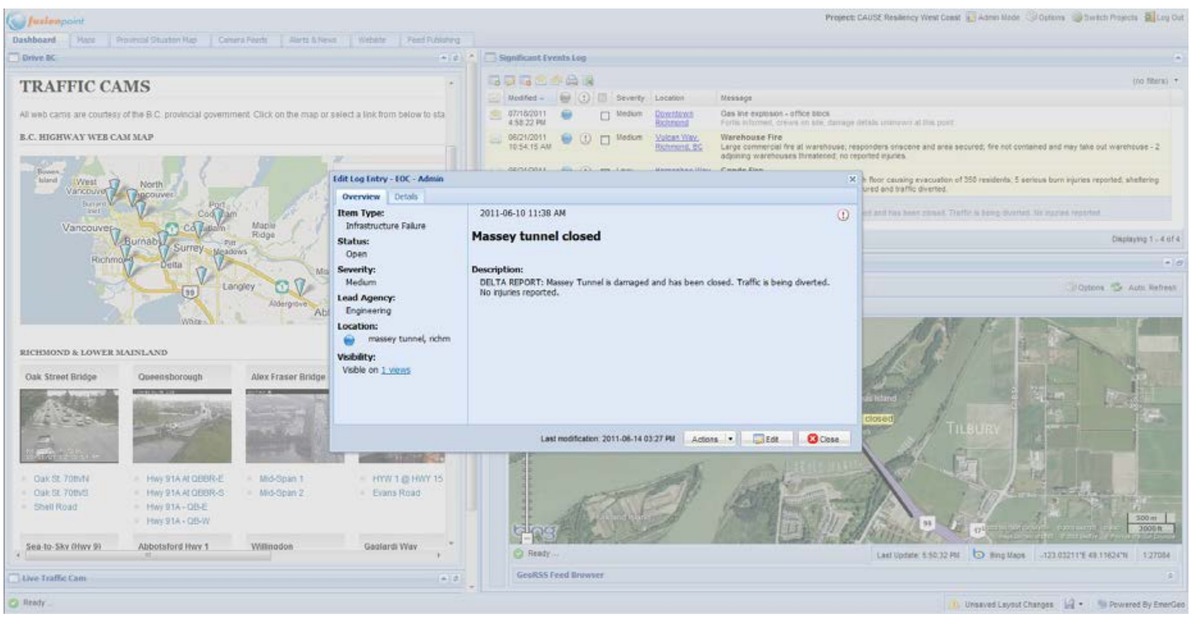


Figure 33 - Massey Tunnel closed incident details

9.3.4 A major gas fire was also reported and captured as an incident (see the log entry in Figure 34).

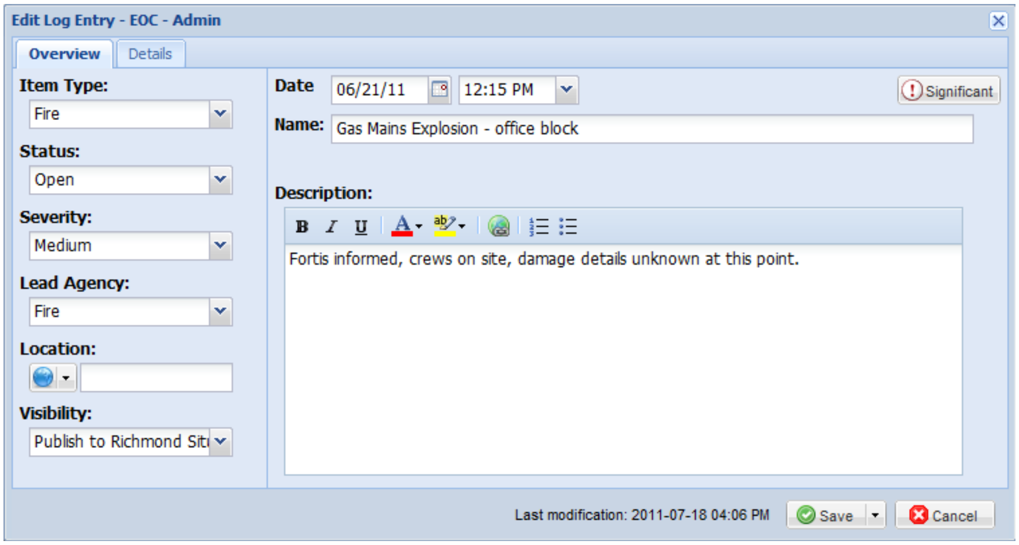


Figure 34 - Incident Entry Log

9.3.5 This was then visible on the dashboard map in Figure 35 along with other earthquake related fires and also visible to local EOC staff and remote Richmond decisions makers on the large situation map in Figure 36.

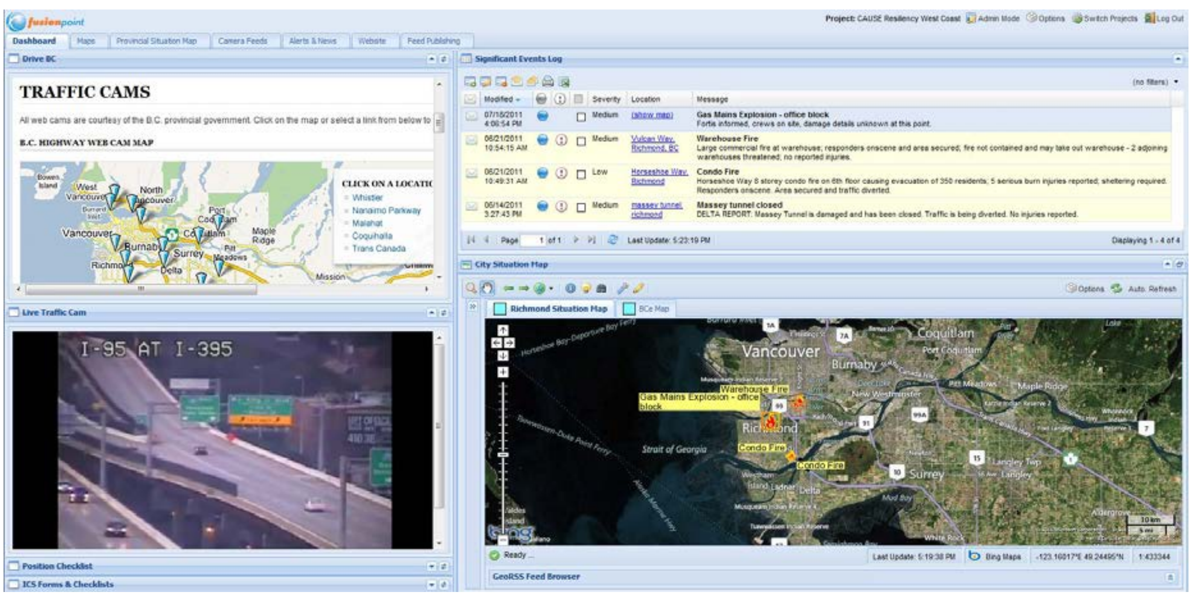


Figure 35 - Richmond Incidents

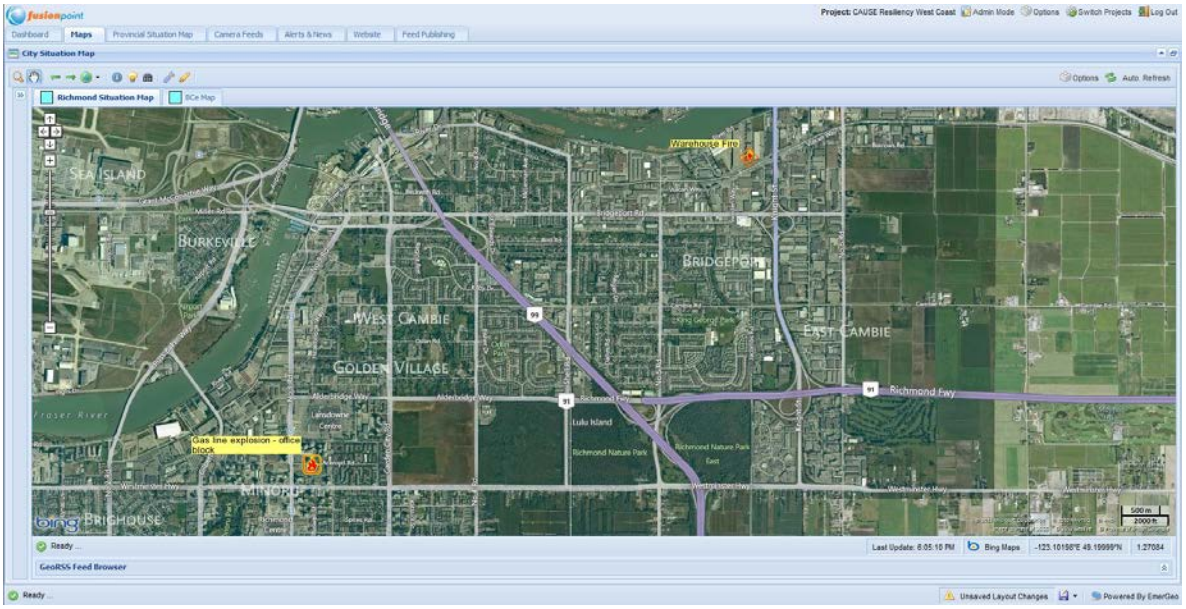


Figure 36 - North Richmond Large Map Overview

9.3.6 The GIS expert also presented Shakemaps generated using the EmerGeo Smart client application which is able to create maps of ground motion (shaking intensity) models based on the USGS earthquake feed input and soils models for the region. The two examples below depict different view/zoom levels and illustrate Modified Mercalli Intensity scale (MMI[6]) value = 4.5 (MODERATE SHAKING) and Peak Ground Acceleration (PGA[7]) = .03 (LIGHT SHAKING AND NO DAMAGE EXPECTED) instances.

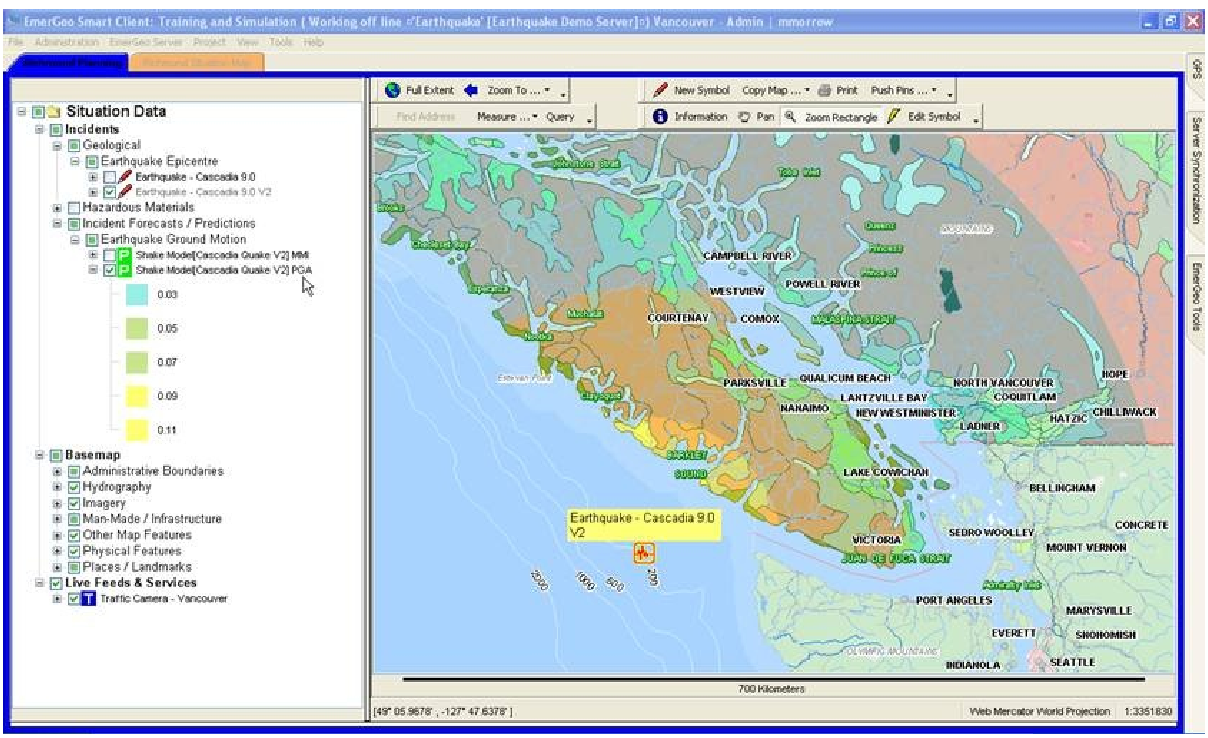


Figure 37 - EmerGeo smart client map - regional

[6] http://en.wikipedia.org/wiki/Mercalli_intensity_scale
[7] http://en.wikipedia.org/wiki/Peak_ground_acceleration

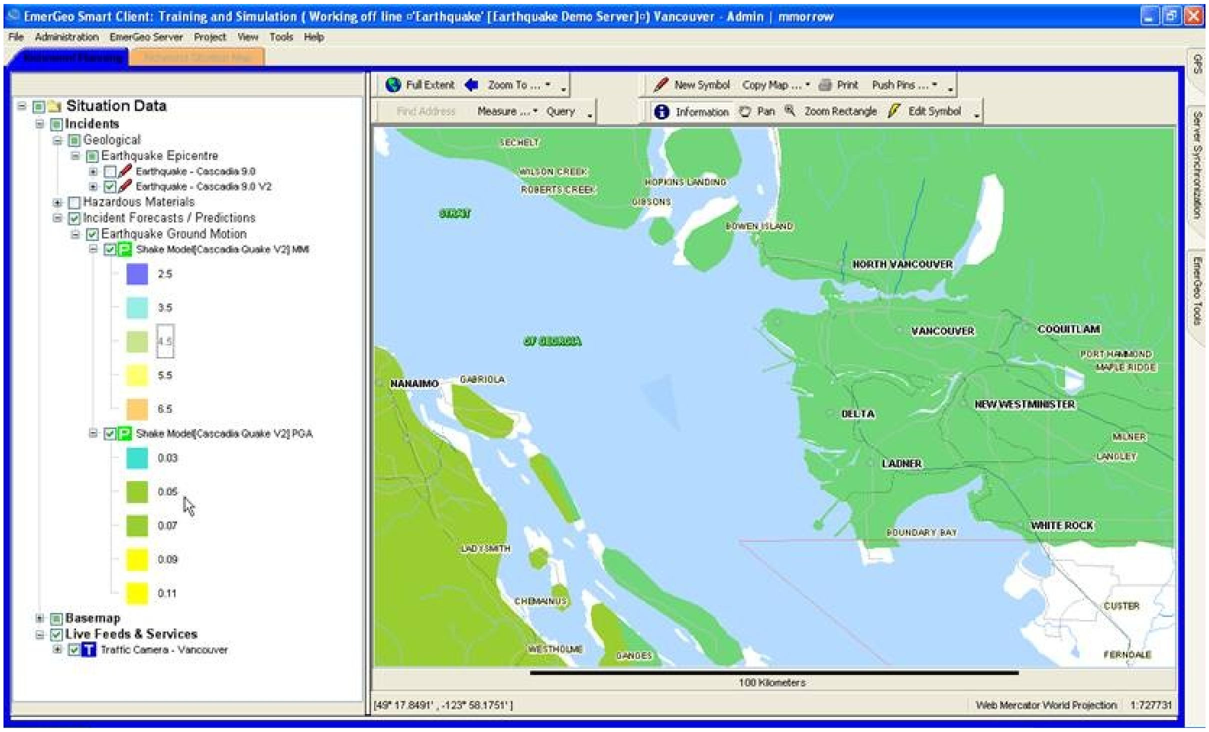


Figure 38 - EmerGeo smart client map - local

9.3.7 In the vignette, the dialogue with the SWPREOC involved a general briefing, i.e. an exchange to and from the Richmond EOC with the BCeMap representation of the EmerGeo Fusionpoint's incidents visible at the SWPREOC providing context for the discussion.

9.3.8 The WMS feed of EmerGeo as presented in BCeMap incidents can be seen in Figure 39.

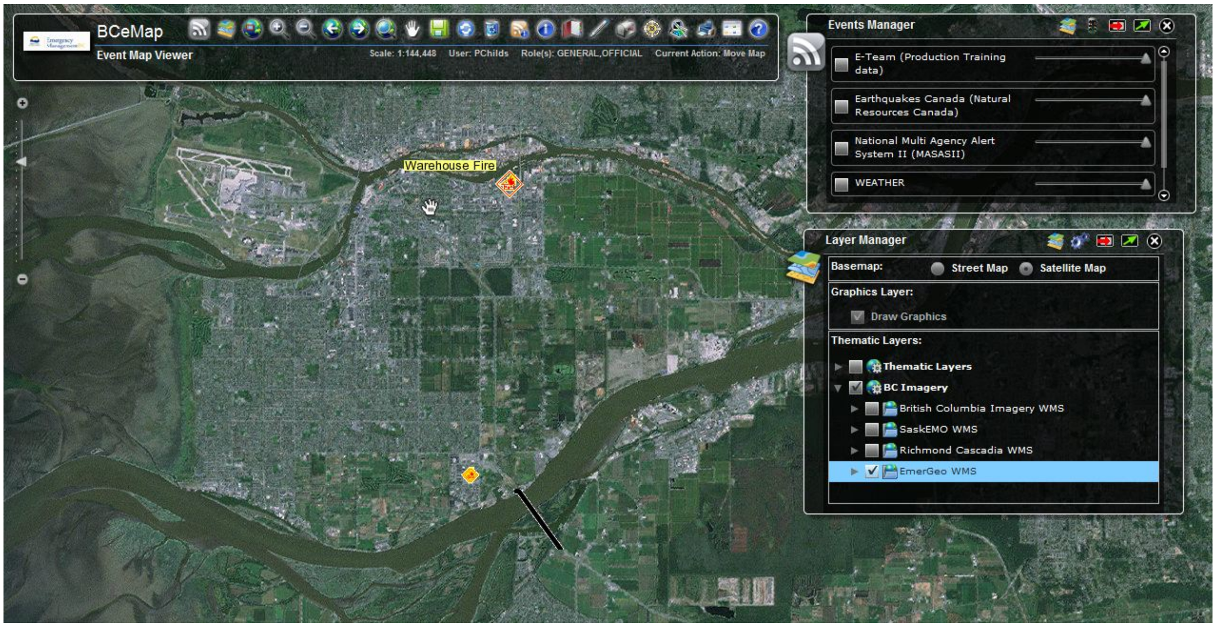


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Figure 39 - EmerGeo Fusionpoint Incidents in BCeMap

9.3.9 Also included as part of the dialogue at the SW PREOC was a discussion with the Provincial Seismic advisor regarding the selection and display of an appropriate damage assessment model from Hazus that could be displayed, indicating the level of damage in Richmond for this event.

9.4 Vignette 2: Experimental Findings

9.4.1 The City of Richmond has been considering implementing a Virtual Emergency Operations centre concept, and the chance to experiment with a hosted version of EmerGeo was welcomed. It offered an opportunity to explore the benefits of a virtual incident management system and appreciate the technology required to use this both locally and remotely.

9.4.2 The staff in the Richmond EOC did observe that, both on the days of the dry run and the main experiment, there was too much focus on the filming goals and not much allowance made for users to examine the actual technology. Hands-on use of the EmerGeo tool was limited, with much of the filming devoted to blue screens. As a result it was felt that more could have gained with respect to understanding of the tool. Subsequent meetings will be arranged however with EmerGeo to follow-up on this matter.

9.4.3 It was determined that, in the event of a real earthquake, it would be useful to have the visual representation from the Smart Client, showing the shaking intensity and the areas most affected by the earthquake, thereby confirming whether or not the ground motion effects of such a large event in the Cascadian subduction zone would affect Richmond significantly. The extent of damage in a given area would be determined fairly quickly from field reports f Having the shake map generated as a live picture would allow those reports to be corroborated by area within Richmond and would also ascertain whether the model is accurate and could be relied on for assessment purposes.

9.4.4 It was felt that this information would also useful for planning responses to specific earthquake scenarios,

9.4.5 The outputs from Hazus-MH, if developed to the point where they could be deemed reliable, would provide additional more specific impact-related outputs which could be used to augment the scenario and broaden the problem appreciation for planning purposes.

9.4.6 From a technical stand point, integration between a municipal instance of an EmerGeo and BCeMap was explored and it was found that it was relatively straight forward to implement a basic Web Mapping Service interface between the two systems. The WMS source can be created in EmerGeo in administration mode in a couple of steps, i.e. selecting the data to be exported and the type of interface (in this case WMS, the other options being KML and GeoRSS). This then creates an external url which can be copied and used by the consuming system. The WMS was consumed in BCeMap by a service on ArcGIS server and then republished as part of the map services to the BCeMap browser client.

9.4.7 There were a number of teething issues and more fundamental issues however with the mechanism:

- The services needed to be published on a port that could be consumed at GeoBC (most ports in BC government networks are blocked above 1500 and the default for EmerGeo was 8888). An open port that did work was 8080.
- The default projections used by EmerGeo was a Web Mercator projection i.e. EPSG:3785 (as originally used by Google) or 900913 (the open-source OpenLayers projection). Neither was supported in BCeMap as these have now been deprecated[8]. The EmerGeo service was re-configured to EPSG:3857 (that also replaced the ESRI:102100) and this could then be consumed by BceMap.
- A more fundamental issue however was that the EmerGeo publishing mechanism creates a new layer in the WMS service for every incident. This is illustrated in Figure 40.

[8] by the Eurpoean Petroleum Survey Group (EPSG) who publish a dataset of parameters for co-ordinate reference system and co-ordinate transformation description

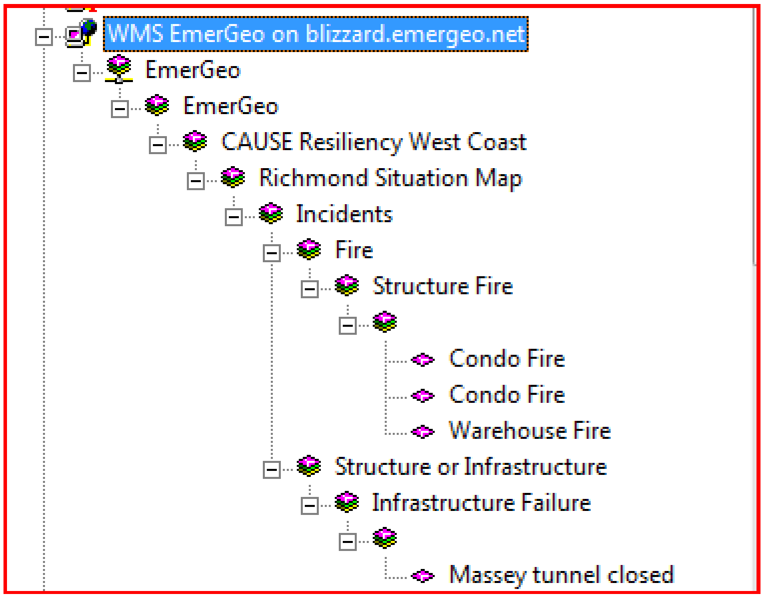


Figure 40 - WMS layer tree

9.4.8 This is a design decision that then allows the user to toggle this layer on and off independently in the consuming system. However the ArcGIS services in BCeMap assumes that the structure of the WMS is not changing and caches the structure, and therefore it does not recognize subsequent incidents. It was not scoped and addressed as part of the project to develop the ability to render new incidents in a standard (i.e. non-changing) set of layers to work with BCeMap. However this could be done if WMS was the preferred method of integration with BCeMap going forward.

9.4.9 In the time available it was also not possible to configure or evaluate the WMS "identify" services i.e. the GetFeatureInfo request service which allows a user to click on an incident on screen and retrieve further data . This is only supported by some WMS services and XML or text is returned. It is unknown how this would need to be configured to support a usable display in BCeMap, however the viewing pane in BCeMap is unstructured therefore the implication is that configuration would have to be done at source. In addition the feature information fields could not be used for filtering the display in the same way that has been configured for MASAS (i.e. if the user is looking for incidents of a certain type or age etc.) Only the fixed layer groupings could be used for this purpose.

9.4.10 It should be noted also that WMS does not specify an incorporated security configuration, and an additional security layer would have to be applied e.g. at the network layer in the form of a point to point vpn or ssl connection.

9.4.11 The experiment showed that sharing information out of a local incident management system to BceMap can be operationally useful, especially for provincial emergency management resources to quickly visualise what is happening o the ground (referenced by situation reports for example). However WMS would not be the best option for this. BCeMap would need to be configured for every source, and the programming and configuration of each source to be compliant may not be trivial. It would be far better if each system was able to publish to MASAS i.e. in a single standard format and there would be no additional or on-going work required in BCeMap to consume each additional source as they came on board.

9.4.12 It would also be possible to host a BCeMap window within EmerGeo (as a pane can be configured to point to the BCeMap url) and this would have been possible if the ssl certificate on the GeoBC delivery site was up-to-date, however this was expired and the security mechanism within the Internet Explorer Browser (used during the experiment) prevented the map from being displayed. The issue could have been fixed or worked around, however it was determined that there is no real operational benefit in having BCeMap hosted within a window in EmerGeo apart from perhaps having all applications grouped together in one container for ease of user access. This does have some merit especially for new users and or users whose training may not have been very recent when the EOC activates, however the user still has to log-on separately to BCeMap and has to toggle between panes to see data hosted in this system vs that unique to EmerGeo.

9.5 Vignette 2: Recommendations

9.5.1 It is recommended that a hosted EmerGeo Fusionpoint or a similar system is considered as a solution for Richmond Emergency Management for both their incident management and awareness component of their Virtual

EOC concept. This solution should be considered alongside other similar solutions against the criteria of cost, benefit and features, and the features should include the ability to consume and publish to MASAS and support remote users.

9.5.2 Based on the findings above it is also recommended that for low cost set-up and maintenance and management of awareness information between systems, that MASAS would be the better mechanism for integration with other systems rather than WMS. In summary the main reason for this are that the source systems would publish data in a consistent and standard format, with fields mapped to filter and display tools in the destination systems (e.g. BcEMap), and there would be no additional work at the receiving systems to be able to consume from additional publishing sources. The MASAS feed also has basic security built in to the standard connection at the application layer.

9.5.3 In the absence of an integrated incident management and awareness system (like Fusionpoint), BCeMap could be rolled out to Municipalities subject to appropriate support and training, however a tool like Fusionpoint could take over the role of situational awareness if all the same sources are available as are available for BCeMap (particularly if the main sources continue to move towards being delivered through MASAS).

9.5.4 It was felt by the emergency management staff at Richmond, that the groundshake outputs from the EmerGeo Smart Client and the Hazus-MH outputs were both very useful and would have application in the event but also in the planning for such an event. Both products may be considered for implementation subject to cost and resource implications.

9.5.5 Although not explored in detail in the experiment, the usefulness of the AMECom truck was apparent, and the potential for use in any number of roles or situations to recover power and/or communications facilities for critical infrastructure. It is recommended that various critical infrastructure operators (for example Vancouver International Airport) could be approached to develop operational procedures to implement the truck in a recovery mode after loss of critical services.

10. Vignette 3: Viaduct Collapse and Crowd-sourcing Incident Information

10.1 Vignette 3: Introduction

10.1.1 This vignette is designed around events after the main earthquake event, centred on action at the Vancouver Emergency Operations Centre (EOC) in response to incidents around the city especially the collapse of part of the Georgia Viaduct as a result of aftershocks. The teams involved at the Vancouver EOC include the 311 contact centre team as well as EOC staff. SFU students were also involved in creating and processing incidents.

10.1.2 In normal operations the 311 contact centre takes calls from citizens requesting service, information or registering a civic concern. The concept is that during a crisis the normal flow of citizen requests will be interrupted and the 311 centre will be able to take on the additional role of assessing reports from the public regarding damage or need for assistance, both from telephone calls as well as social media websites. Such candidate data sources include Twitter and Facebook. For the experiment, Ushahidi was chosen since it is a geospatial reporting technology that has been developed by an open source project and sites have been set up and used in the recent major Christchurch and Honshu earthquakes. Ushahidi has also been the subject of research by the SFU Faculty of Communication, Art and Technology, and a site set up for one of their projects was used for this experiment.

10.1.3 The objectives of the vignette were to experiment with the processes that are required for the 311 team to process the information from such sources and submit that information into the existing formal emergency management systems. In this case the formal system was chosen to be E Team and there is also an interface from E Team to BCeMap, as a means by which the information could also be shared with the South West PREOC. This supports a discussion around a request for bringing in heavy machinery to deal with rubble disposal.

10.1.4 As a side-event in this vignette a picture was taken on an Android phone of the EOC board room during the experiment briefing. The picture was tagged and uploaded to SAMapper, one of the US technologies involved in the experiment, and this tagged report and image was sent from SAMapper through MASAS to BCeMap to demonstrate the technologies and interfaces (not an integral part of the overall scenario).

10.2 Vignette 3: The Technologies

10.2.1 The main technologies involved in this vignette are illustrated in Figure 41**Error! Reference source not found.**. The process starts with the ability for the public, played by SFU students in the experiment to capture events on the streets as reports in Ushahidi, using cell phones or laptops e.g. in a coffee shop. Volunteer adjudicators are then able to vet the reports submitted and if approved, they are then displayed on the public facing Ushahidi web site that was set up by for the experiment.

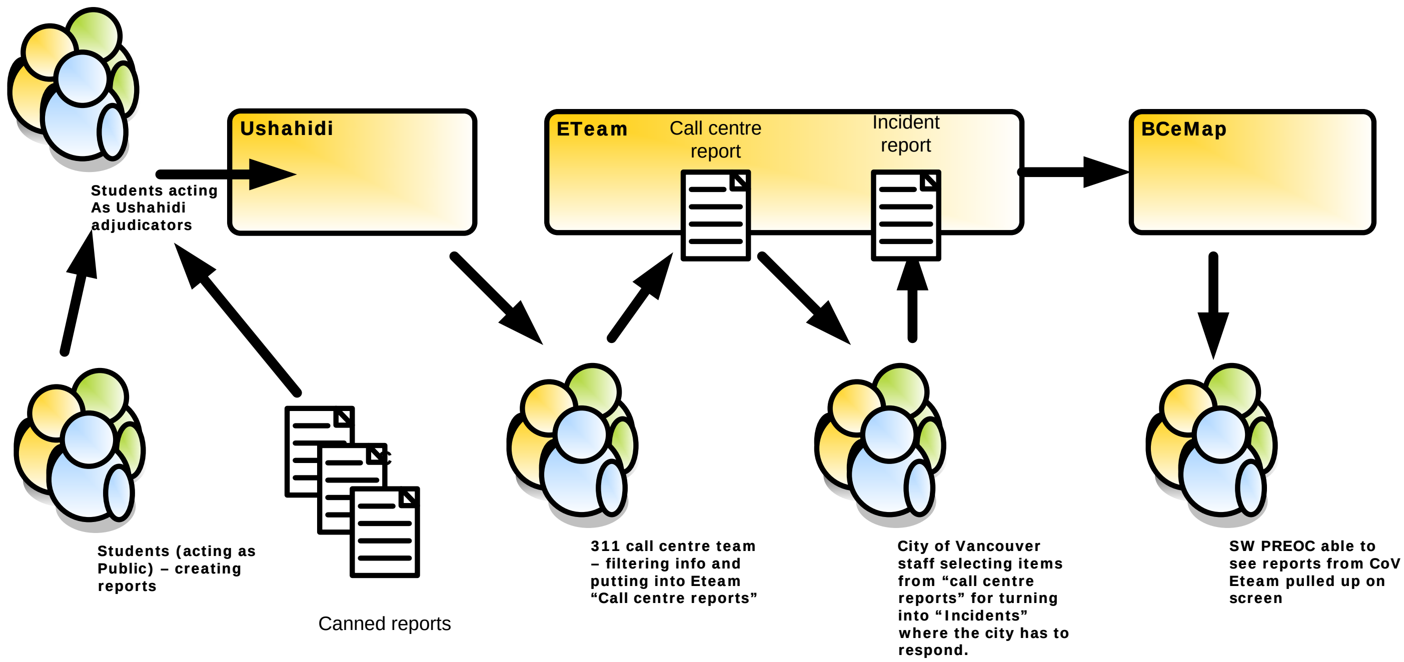


Figure 41 - Vancouver EOC Crowd Sourcing Flow

10.2.2 The 311 contact centre team would then review all the events and, if a report seems real and/or has sufficient corroboration then they would translate the message into a "Call Centre Report" in E Team, in the same way that a telephone call from the public might be captured from the public into E Team.

10.2.3 The City of Vancouver EOC team would then see the call centre reports and determine whether it is an incident that the city has to respond to. If so then the reports would be turned into "incident reports" in E Team and tracked as for any other incident captured in that system. The interface to BCeMap allows the incident to be published to BCeMap and for the incident details to be visible if the user selects the E Team layer in the user interface.

10.3 Vignette 3: The Action

10.3.1 The action centres on members of the public observing a section of the Georgia Viaduct collapsing in the vicinity of where the viaduct crosses Quebec Street, near BC stadium place.

10.3.2 A report was entered into Ushahidi by students acting as the public and is validated and presented in the Ushahidi Vancouver Earthquake web site. Figure 42Figure 43**Error! Reference source not found.** illustrates the report capture screen in Ushahidi and Figure 43 illustrates how this would was presented in the public web site display once the report was validated by the Ushahidi volunteers. This step is to filter out reports that are clearly spurious or reveal personal information and would be supported by the Ushahidi site volunteers.

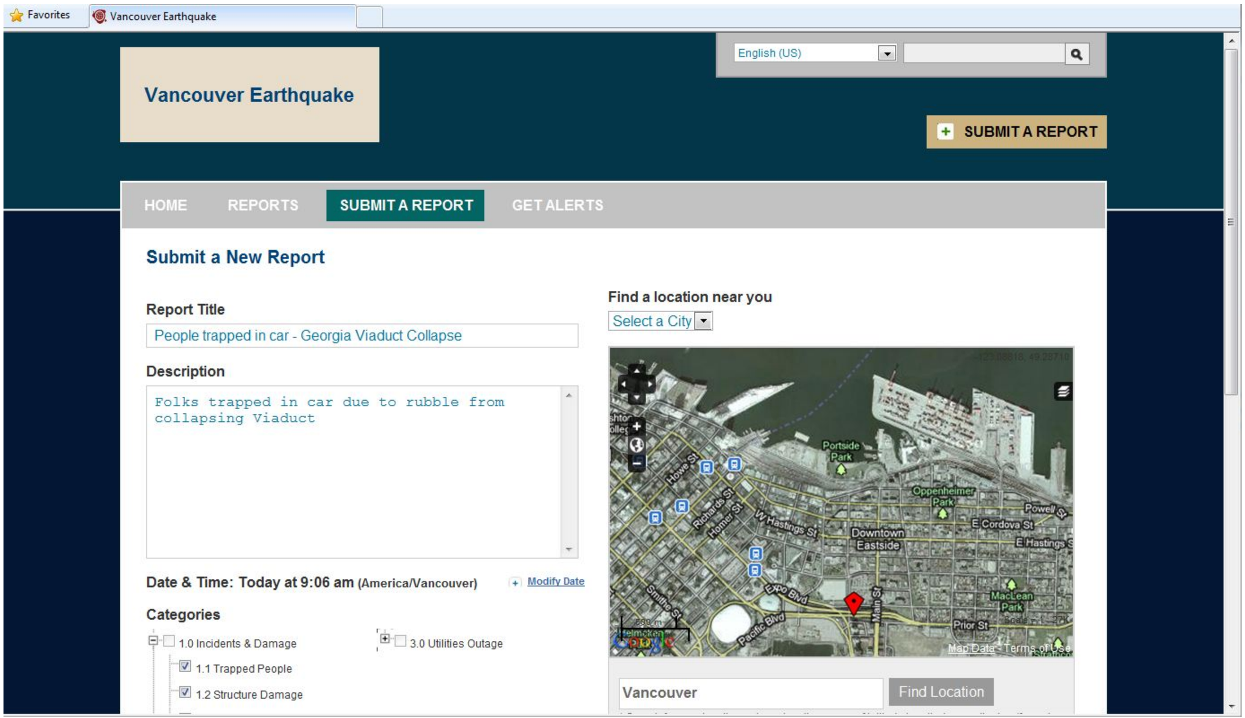


Figure 42 - Report capture process

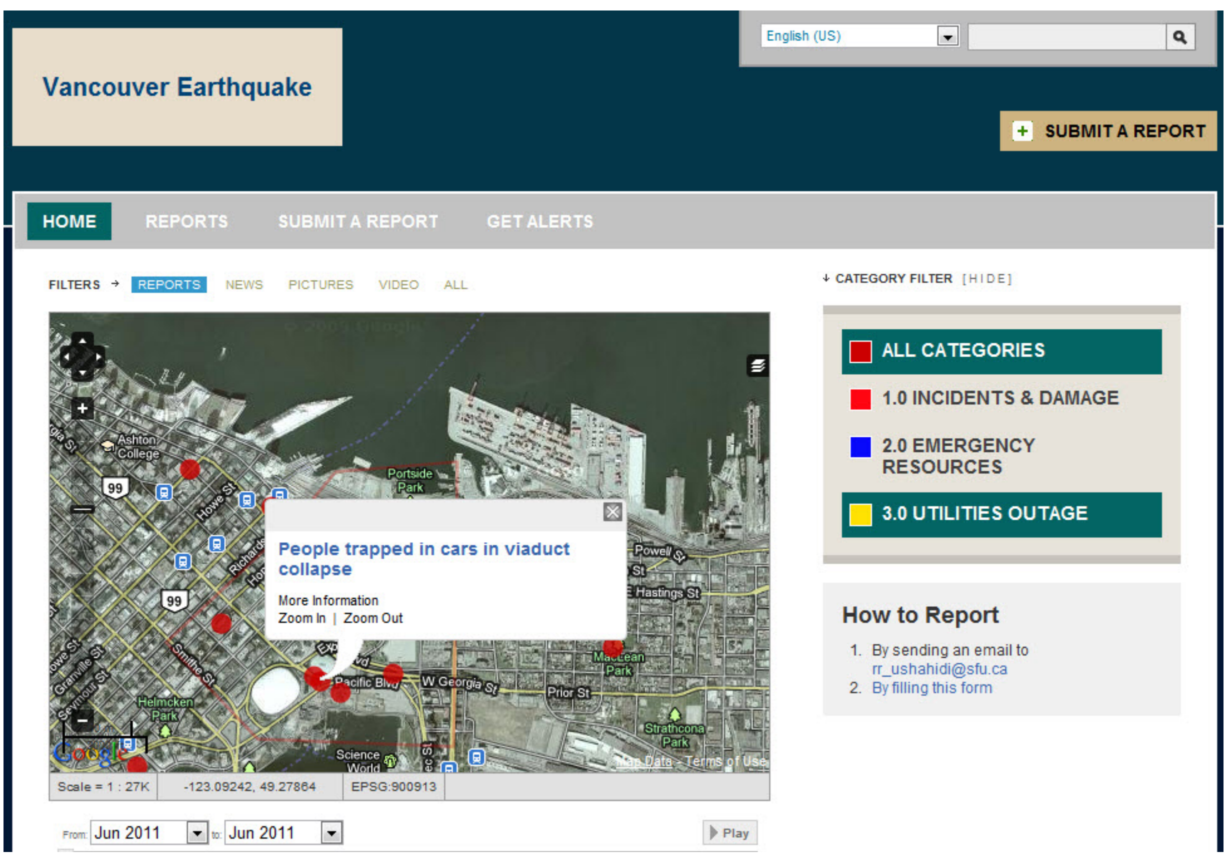


Figure 43 - Reports of people trapped in cars near the Georgia Viaduct

10.3.3 The 311 call centre team then reviewed all the messages in Ushahidi (see Figure 44)**Error! Reference source not found.** for another example report) which can also be reviewed in list form (see Figure 45).

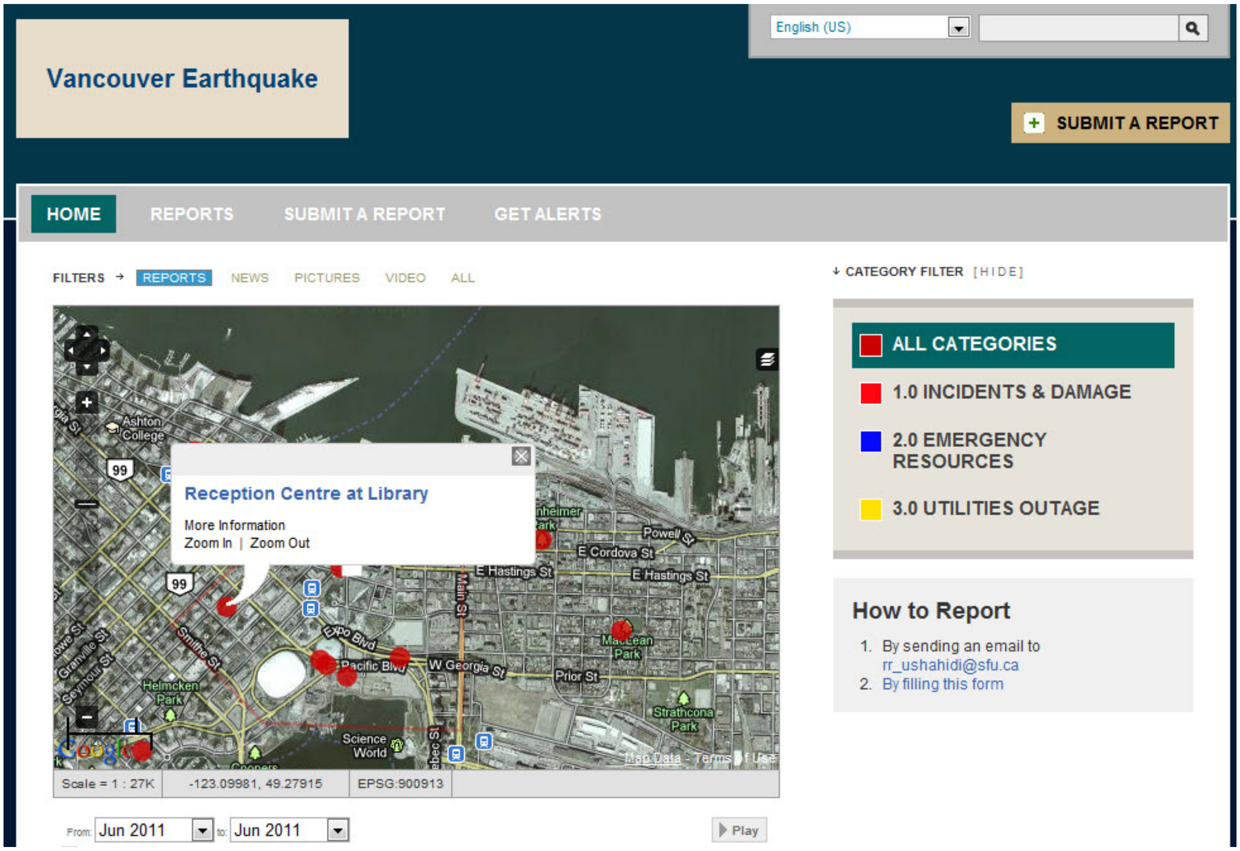


Figure 44 – Other Ushahidi Reports

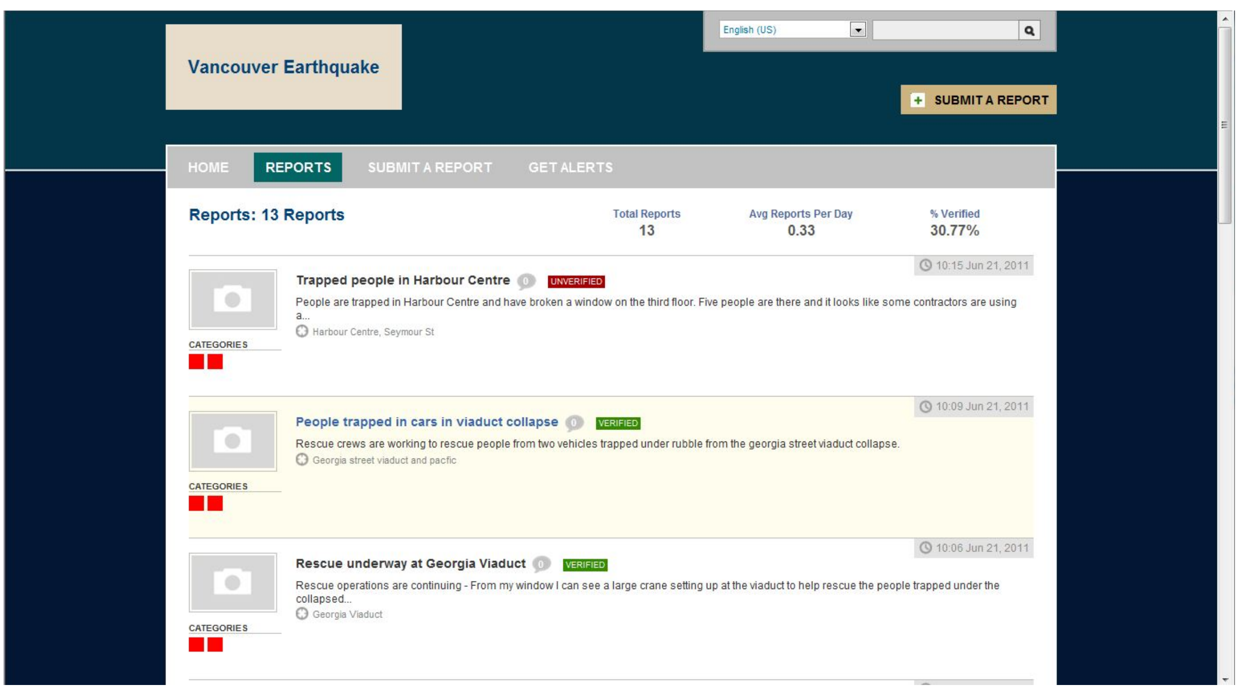
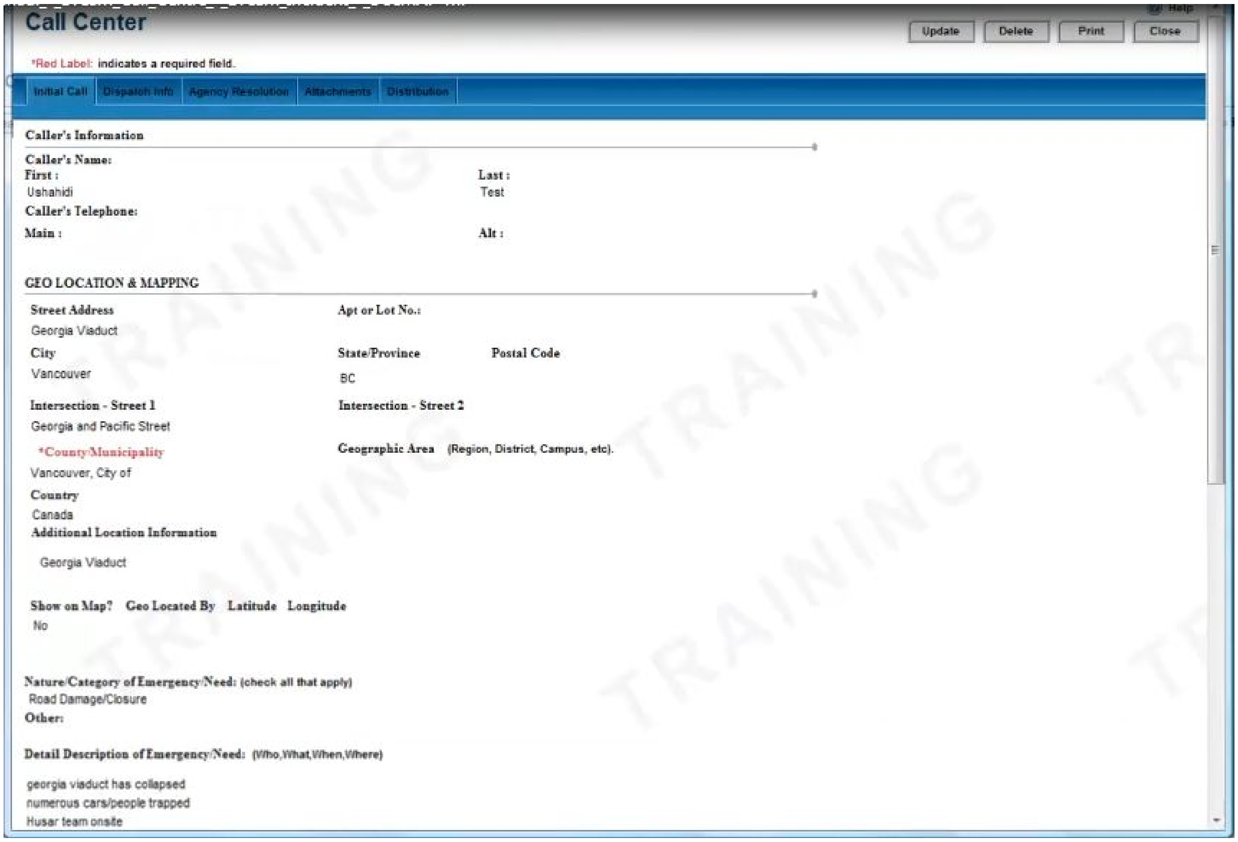


Figure 45 - List view of reports

10.3.4 Once the viaduct collapse report has been determined to be of interest to the city (especially as it involves both an incident involving people requiring assistance but also failure of a major piece of city infrastructure, then the call centre report in E Team is captured (see Figure 46).


Call Center

Update | Delete | Print | Close

*Red Label: indicates a required field.

Initial Call | Dispatch Info | Agency Resolution | Attachments | Distribution

Caller's Information

Caller's Name:
First : Ushahidi
Last : Test

Caller's Telephone:
Main :
Alt :

GEO LOCATION & MAPPING

Street Address: Georgia Viaduct
Apt or Lot No.:
City: Vancouver
State/Province: BC
Postal Code
Intersection - Street 1: Georgia and Pacific Street
Intersection - Street 2
*County/Municipality: Vancouver, City of
Geographic Area (Region, District, Campus, etc).
Country: Canada
Additional Location Information: Georgia Viaduct

Show on Map? Geo Located By Latitude Longitude
No

Nature/Category of Emergency/Need: (check all that apply)
Road Damage/Closure
Other:

Detail Description of Emergency/Need: (Who,What,When,Where)
georgia viaduct has collapsed
numerous cars/people trapped
Husar team onsite

Figure 46 - Call Centre Report in E Team

10.3.5 When reviewed by staff in the Vancovuer EOC the call centre report was be converted to an incident report for further action and management. See Figure 47 for the report and Figure 48 for the list.

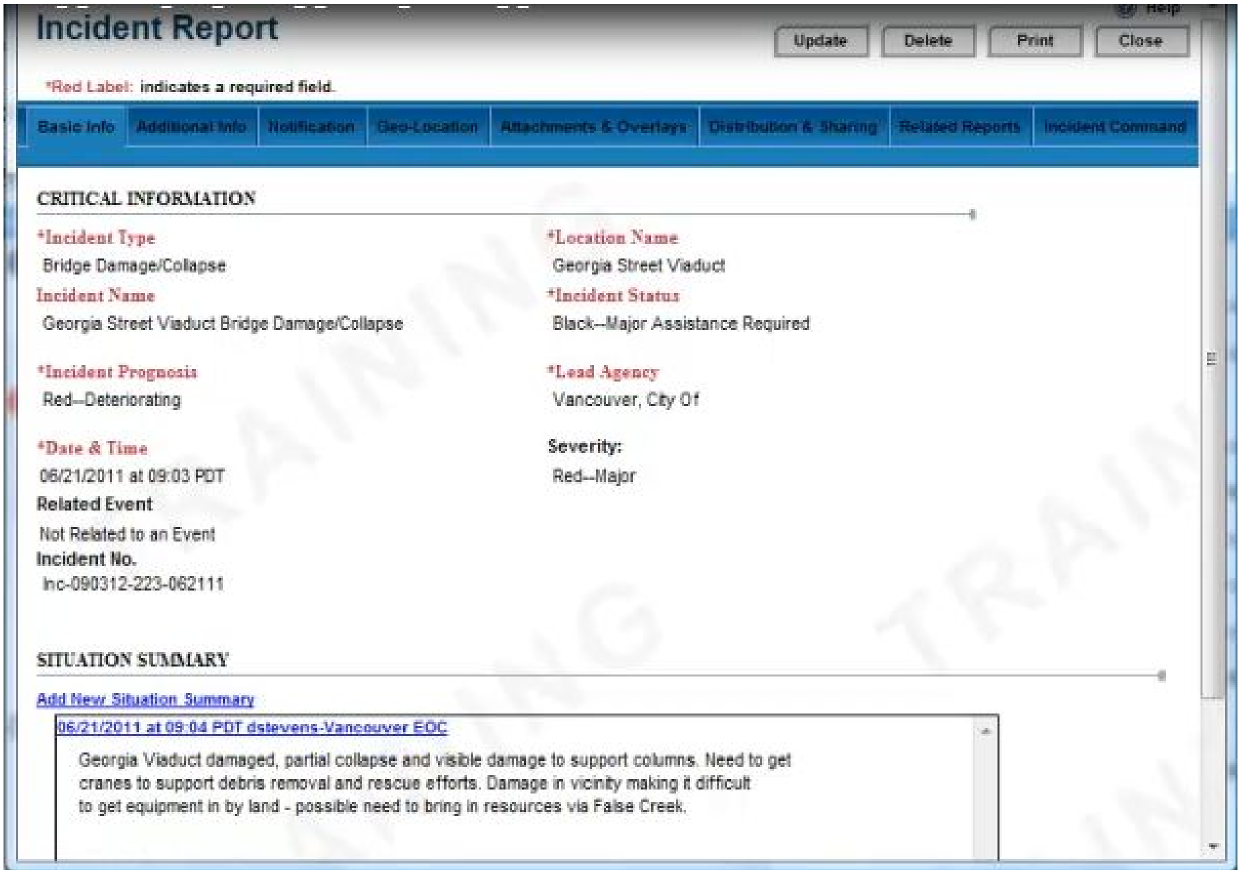


Figure 47 - E Team incident report

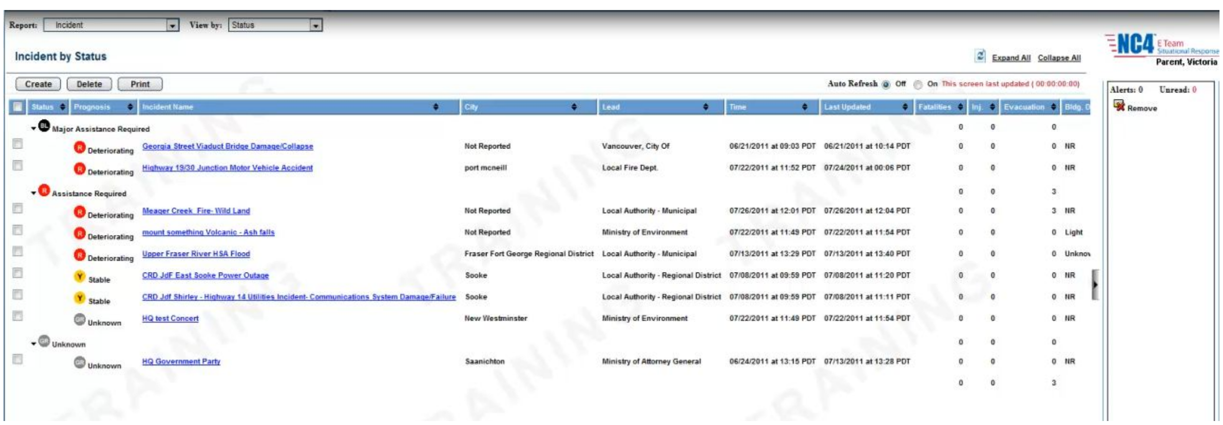


Figure 48 - E Team incident list

10.3.6 In the experiment, subsequent to the report being published and other reports being received the City EOC determined that there were issues gaining access for cranes clearing rubble in the vicinity of the viaduct and a call was executed between the City EOC and the South West PREOC to discuss the location of the viaduct collapse, the difficulties getting cranes into the area due to other road closures and an alternate means of bringing cranes in by barge was discussed. The visual representation of the collapse in BCeMap can be seen in Figure 49.

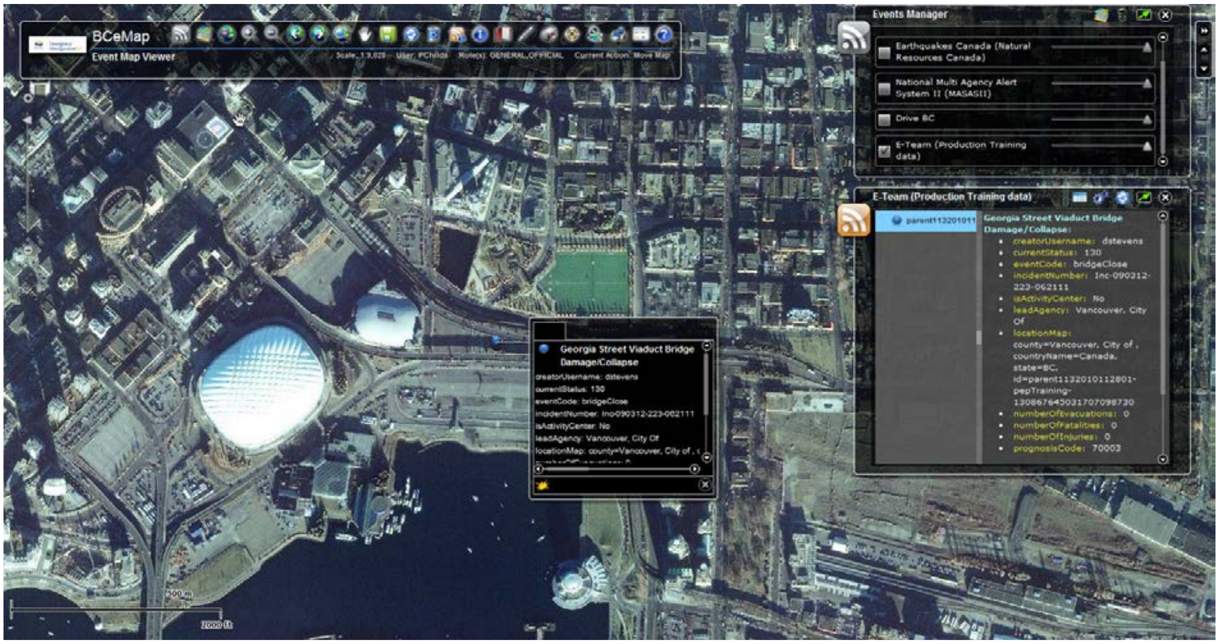


Figure 49 - Representation of Georgie Viaduct collapce in BCeMap

10.4 Vignette 3: Experimental Findings

10.4.1 The 311 contact centre is a relatively recent addition to the City's capabilities and the team was very interested in developing operational procedures with the Vancouver EOC to assist with major incidents and explore ways in which the resource could be put to best use in these circumstances.

10.4.2 The use of social media as a means to interact with the public is a major topic in the emergency management community due to the efficiencies in the gathering of information that may otherwise not be available, especially when resources are heavily engaged with other tasks.

10.4.3 The experiment only covered the one way flow of information from the public to the emergency management organizations, but the flow could also take place the other way. For example the set-up and availability of reception centres could be communicated out to the public through a site such as Ushahidi (as illustrated in Figure 44 above).

10.4.4 As part of the experiment it was discovered that there was a flaw in the E Team system that prevented call centre reports from being converted automatically to incident reports, and this has been reported up to the E Team/NC4 help desk.

10.5 Vignette 3: Recommendations

10.5.1 It is recommended that the following areas could be explored in future experiments with such technologies.

10.5.2 Having proved the interest and practicality of having 311 staff execute the role of vetting Ushahidi reports, it would be beneficial in terms of time saving to be able to automatically extract the corroborated reports from Ushahidi into E Team. It is understood that at a system level it should be possible to interface with Ushahidi, or such an interface could be built by the open source community. This interface should be able to pull specific reports and push into E Team using a web service on E Team available for that purpose. Ideally there would be a control in the Ushahidi screen that could be invoked on a selected report and any additional information added (e.g. details on the user pushing the data, and any corroborating information from other reports that may be added) and then the Call centre report would be generated automatically.

10.5.3 Another option is that a similar adapter could be invoked (instead of, or in parallel) that could create a MASAS message and pushed to a MASAS hub for wider consumption, however this would more likely be a step further into the process (i.e. when the call centre report is converted to an incident in E Team).

10.5.4 Similar interfaces with Facebook and Twitter should also be considered using a similar process. This would then

cover the main sources of public generated information.

10.5.5 Operational procedures around publishing city Emergency Social Services resources (e.g. reception centres, etc.) and people finding processes[9] could also be explored as a means of communicating efficiently with the public.

10.5.6 It is also recommended that the possibility of adopting the process above as a true operational procedure is evaluated. As part of that evaluation, the means of marketing to the public the existence, purpose and usage guidelines for specific Ushahidi, Facebook and Twitter web sites should be defined, together with identifying the funding and/or messaging to the media required for such an eventuality.

[9] It was observed that the public trying to find relatives was a significant use of the Honshu Ushahidi web site following the major earthquake in Japan.

11. Vignette 4: SW PREOC Regional Roll-Up

11.1 Vignette 4: Introduction

11.1.1 This vignette consists of the overall view of the main event and subsequent events from the perspective of the South West PREOC during a regional roll-up and discussion between the Director, Operations and Logistics positions. The vignette showcases BCeMap and the ability to provide situational awareness across the province, and also the CAP/ATOM Message Generator, a tool that was built specifically for the project and has been turned over as open source code to the MASAS development community. The scenario generator produces messages that simulate inputs from various other existing and candidate sources that could be developed, if there was funding and the aspiration to implement from an operational perspective.

11.2 Vignette 4: The Technologies

11.2.1 BCeMap is described in Section 6.2, and the scenario generator is described in Section 6.8 and the MASAS hub is described in Section 6.10.

11.2.2 The scenario generator had several message sequences loaded in to support the various vignettes in this project and provide context for the participants. Several of these scenarios were run back to back to provide the context for the users through BCeMap for this particular vignette.

11.2.3 There were two alternative viewing technologies that were set up to consume messages from the MASAS hub and allow Federal and other observers of the experiment to follow along after the initial briefing session given at the start of the day. These were:

- the MASAS viewer (at http://cause.masas.ca/viewer and also see Section 6.10.3) which had a default password set up to allowed any user using this url to connect and observe the action. See the screenshot in Figure 50.

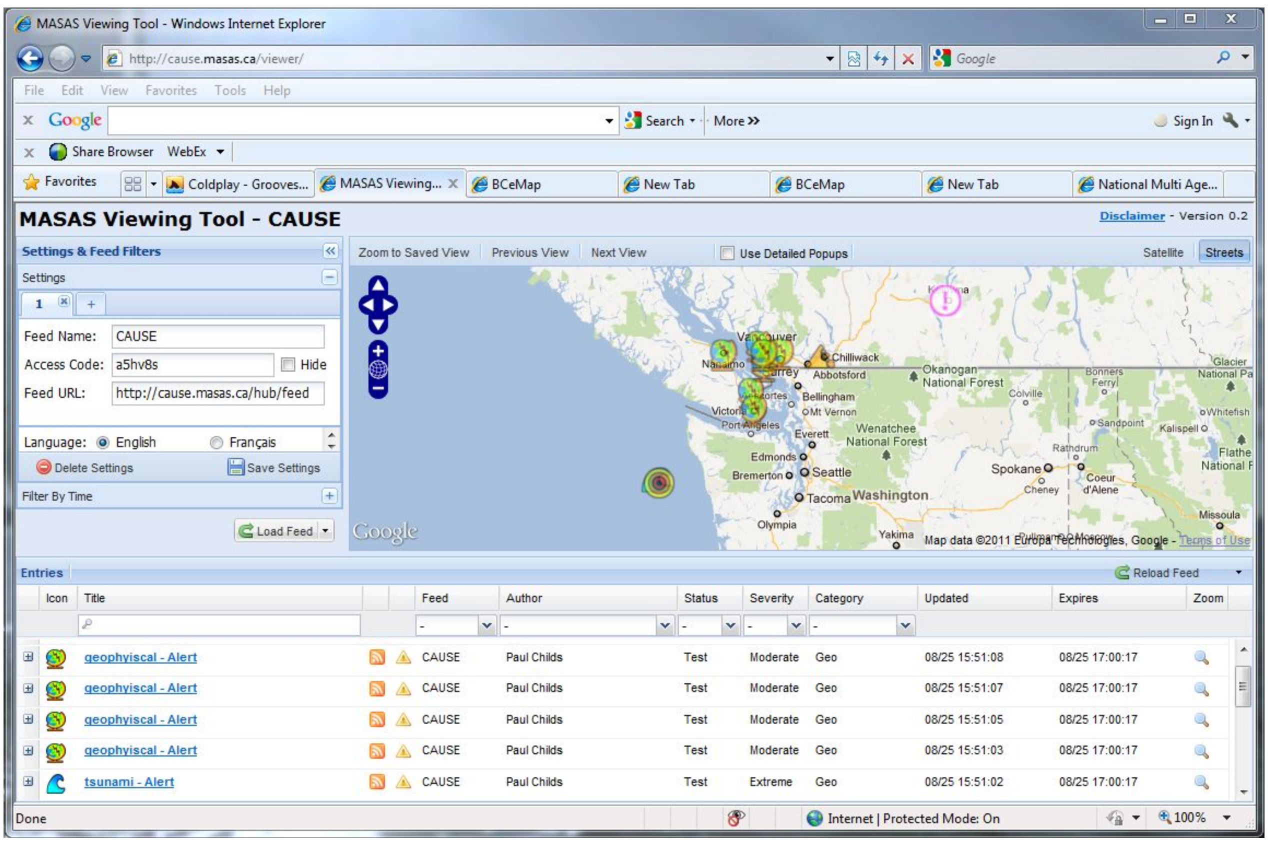


Figure 50 - MASAS online viewing tool

- In addition an ArcGIS web site enabled with the open source MASAS ESRI Flex Tools was configured to point to the CAUSE MASAS hub. This was established by the MASAS National infrastructure Team (see Section 6.11 and the screenshot in Figure 51).

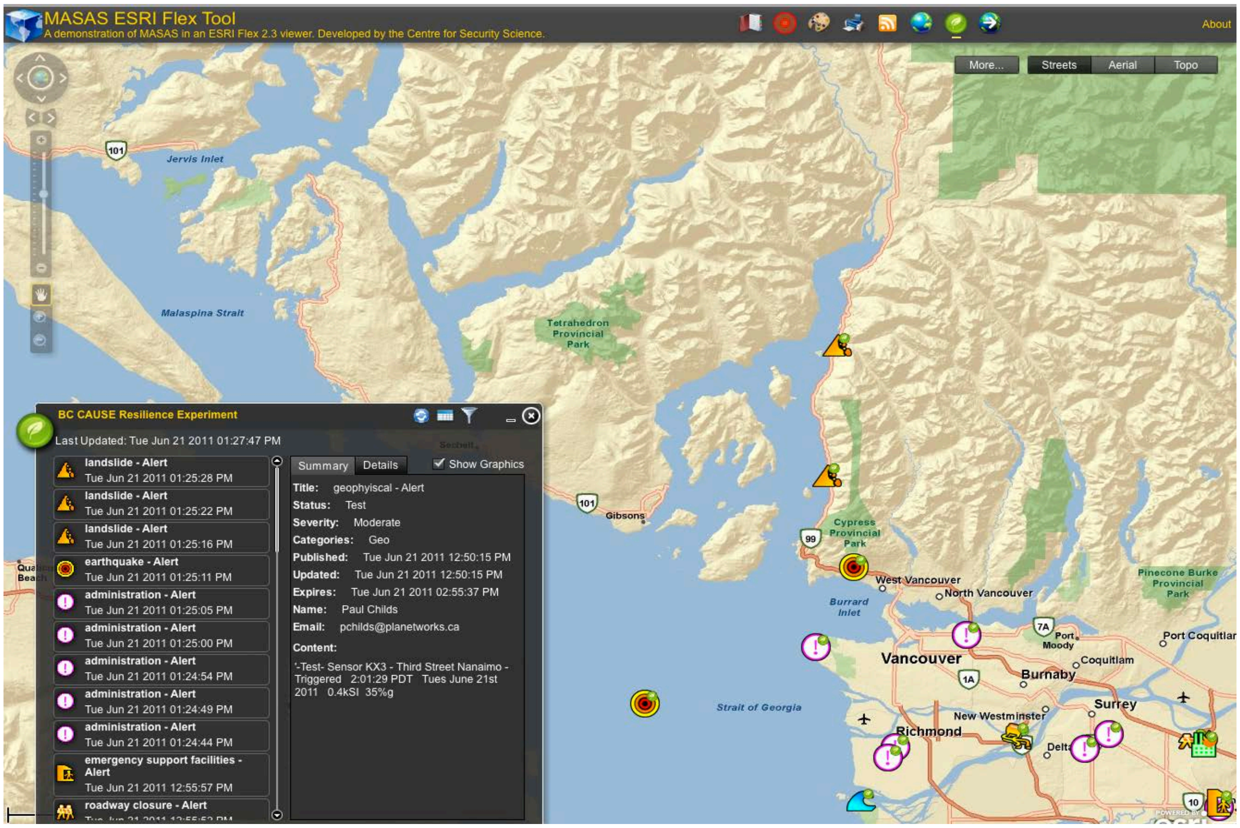


Figure 51 - MEFT Tool View of CAUSE experiment.

11.2.4 Several sources were simulated for this vignette as shown in Figure 52, including:

- Strong Motion and Bridge Seismic sensors that are part of the Smart Infrastructure and Monitoring System (SIMS) that is being developed by UBC on behalf of the Ministry of Transportation.
- The Drive BC feed for road closures
- The NRCan feed for earthquakes
- A potential Tsunami Alert messaging application that would be managed by the PECC

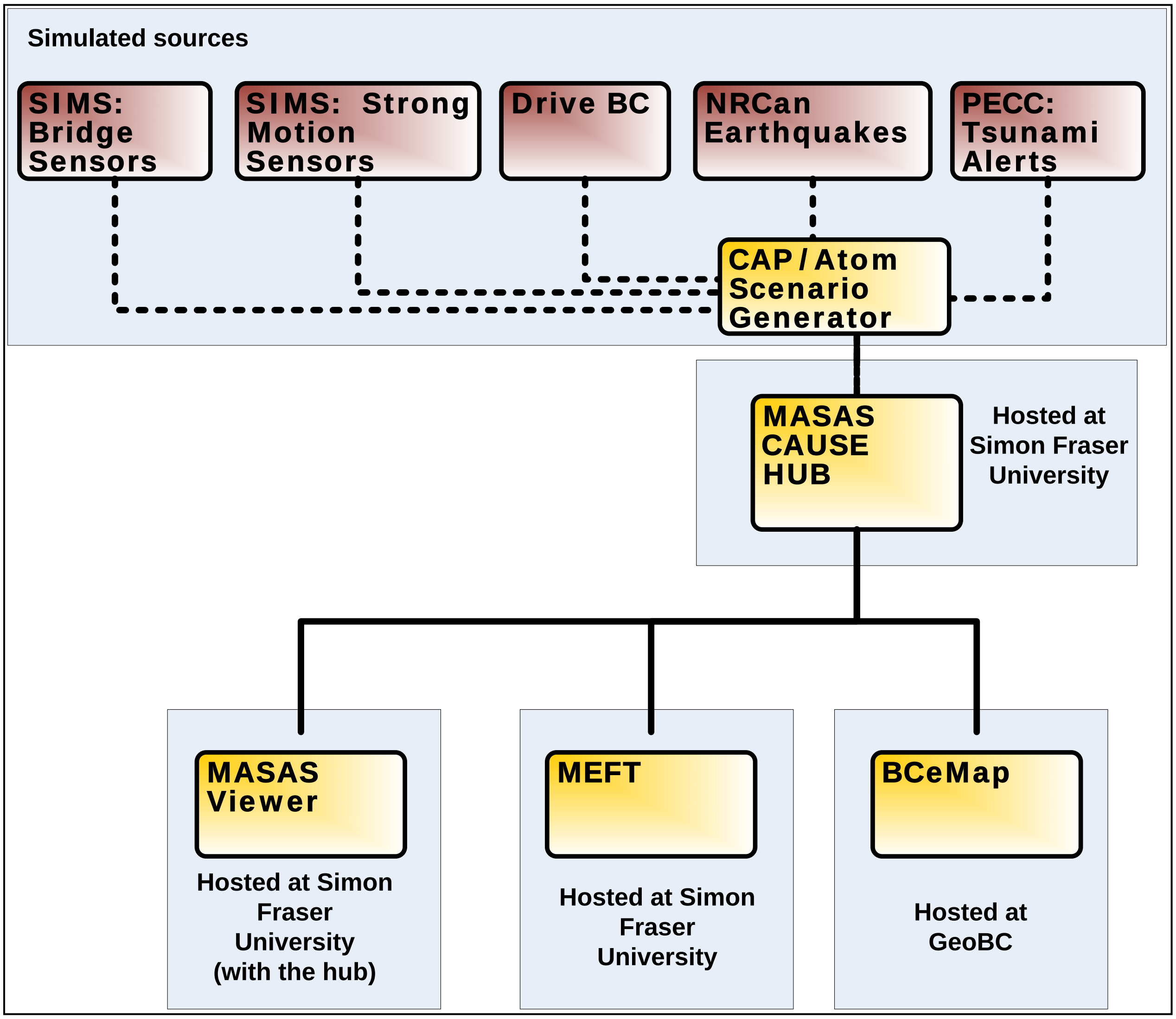


Figure 52 - MASAS Hub and Event Viewing Options

11.2.5 For the purposes of describing the action in this vignette the output as presented in BCeMap is used for the rest of the descriptions.

11.2.6 Core to this vignette and most of the other vignettes is the use of BCeMap as a key presentational tool for the Province of British Columbia. An important part of the leave-behind for this experiment is the development of the interface from MASAS to BCeMap. This is covered in detail in Appendix A and this vignette was one of the main testing grounds for many of the events and alerts that might be pushed to BCeMap.

11.3 Vignette 4: The Action

11.3.1 The CAP/Atom message generator was used to simulate the main earth quake event and an USGS tsunami warning and these were the first events published to the MASAS hub. In a real situation the earthquake information would come from NRCan Earthquakes Canada who now have a live feed of earthquake events available, and this could also be augmented with a feed from the USGS (who are also able to issue earthquake events automatically, with accompanying Tsunami alerts). The simulated messages are illustrated in Figure 53.

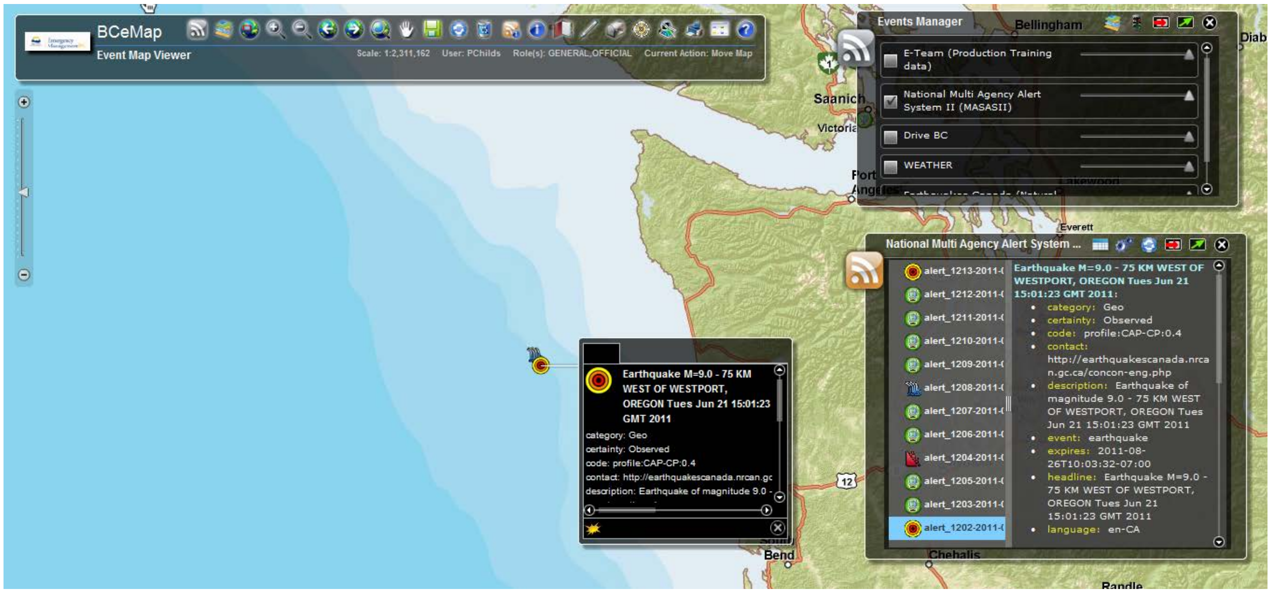


Figure 53 - Cascadian Subduction Zone Earthquake

11.3.2 In addition to the main event, the experiment simulated the possibility of MASAS being fed information from a number of other sources that would be useful in the immediate aftermath of an earthquake. The first such source was an array of strong motion sensors that are designed to detect acceleration and displacement and are located in various places around the lower mainland (many schools and universities) and are networked into the Smart Infrastructure Monitoring Systems (SIMS).

11.3.3 The output of these sensors could be used to create MASAS alerts for spectral intensity above a certain threshold. UBC and the Ministry of Transportation were approached and have expressed interest regarding the possibility of implementing this interface; however, the recent global seismic events and other pressures on the SIMS project prevented this initiative from being progressed for the purposes of the experiment.

Figure 54 - Strong Motion Sensors

11.3.4 The output from bridge sensors was also simulated in this Vignette. All modern bridges in the lower Mainland are being fitted with seismic sensors and stress gauges and monitoring systems that can indicate whether a bridge or

bridge component has been damaged, or may have been subject to shaking that exceeds the bridge's design parameters through extrapolation based on measurements from nearby sensors. The monitoring system could then output messages useful to Emergency Management organizations for each affected bridge that indicates whether action needs to be taken e.g. that the bridge needs to be inspected and/or closed.

11.3.5 The output of 2 potential bridge sensor alerts is illustrated in Figure 55.

Figure 55 - Bridge Sensor Alerts

11.3.6 The experiment also simulated the process by which the Provincial Emergency Coordination Centre (PECC) might issue the BC specific alerts based on the Tsunami alerts received from the West Coast and Alaska Tsunami Warning Centre (WCATWC).

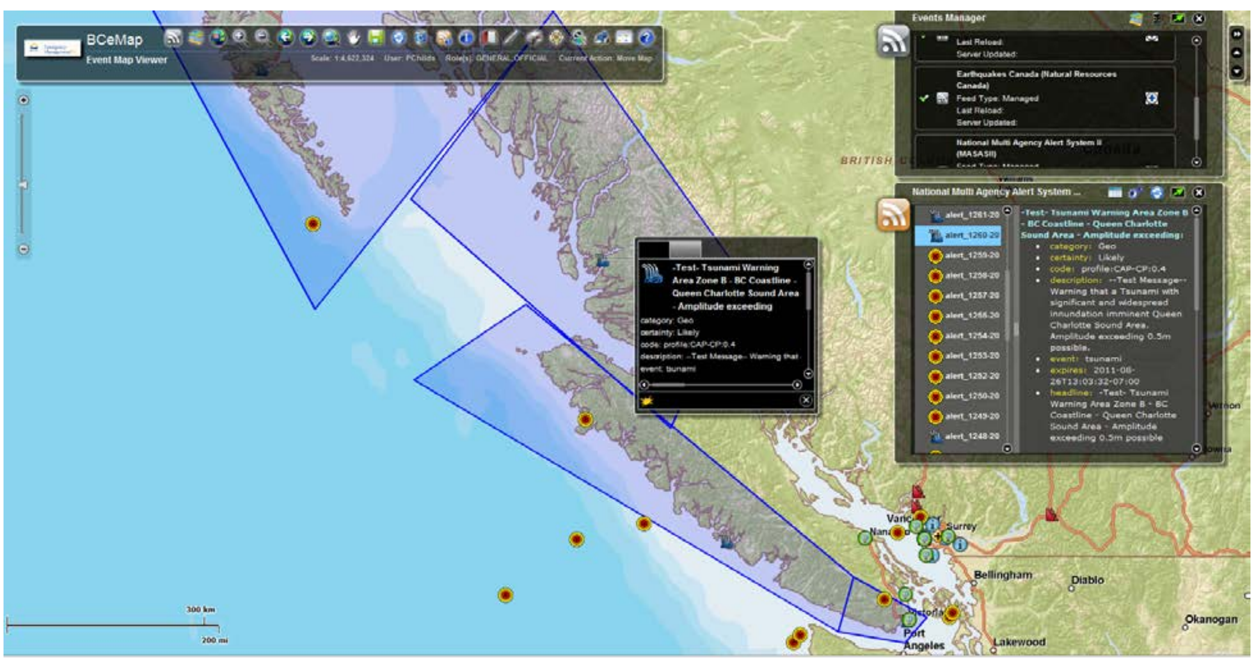


Figure 56 - Tsunami Alerts

11.3.7 Figure 56 shows how tsunami warnings might be represented in BCeMap using Polygons for each of the designated warning areas (Areas A through E) together with additional information regarding onset and wave heights.

11.3.8 To support the issuing of these messages from the PECC it would be possible to implement a desktop based

application that would be similar to the CAP/Atom message builder, but with a simpler interface and pre-configured polygons for the warning areas. This would be capable of publishing the warnings to MASAS and thence to other consuming systems. This step would need to be inserted into the operational procedures in EMBC/PECC, most likely to take place after the Provincial Emergency Notification System (PENS) is activated to issue the time critical notifications. This would still be of value to the Emergency Management community as Tsunami effects can last more than 12 hours after the main event.

11.3.9 It should also be possible to track the status of municipal EOC activations, declarations of emergency, and evacuations, through alerts communicated from municipalities possibly via MASAS. It is not discussed here what system(s) would generate these messages (i.e. whether this is possible from municipal systems themselves, or captured and disseminated at a provincial level (from E Team or other systems), however the simulator allowed an EOC activation to be represented in BCeMap, to show what this might look like if such notifications were available. See Figure 57.

Figure 57 – Vancouver EOC Activation event

11.3.10 BCeMap already has interfaces to Drive BC and is therefore able to present highway status information from a live feed. In the experiment several rock falls were simulated, one in the Fraser valley near Hope, effectively blocking off transportation to and from Vancouver to the East and two rock falls on the sea to sky highway which isolates Vancouver to the north. This circumstance results the SW PREOC having to consider moving resources from the interior through the United States. This has been a real scenario in the past during the avian flu epidemic. Transportation would move south via Osoyoos and across one of the roads or highways south of the parks in Washington and then North up through the I5 corridor. The rock falls/road closures are illustrated in BCeMap in Figure 58. The scenario and investigation of the highways in the USA by the SW PREOC is discussed further in the next vignette.

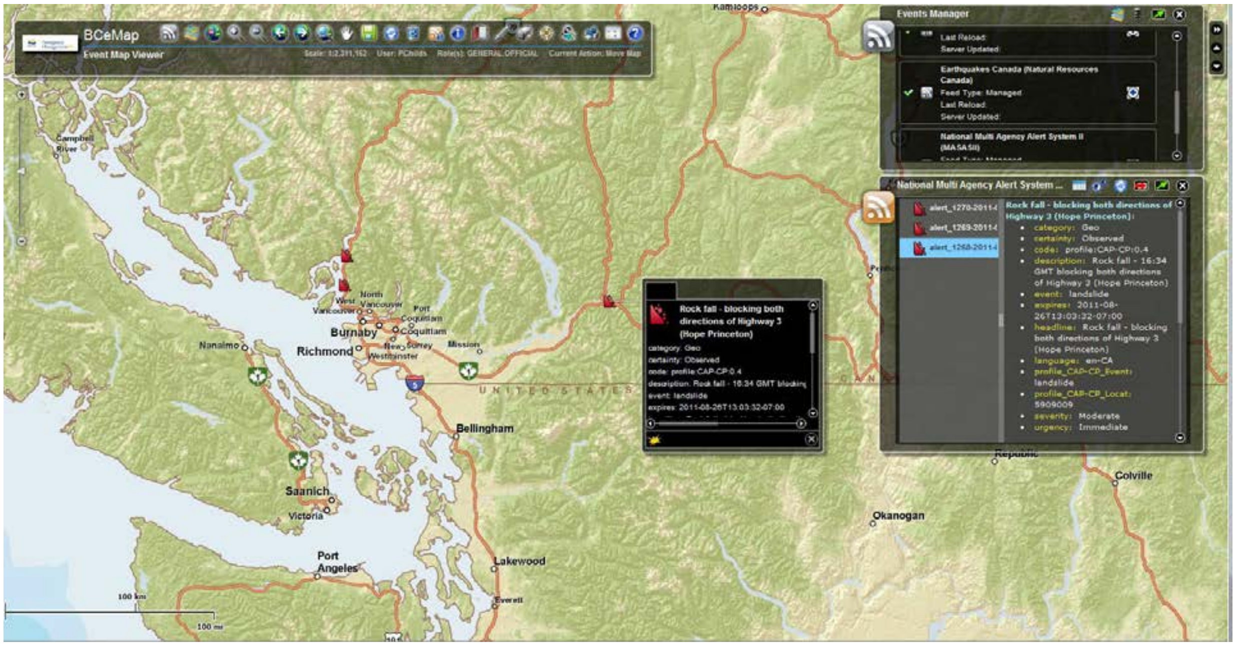


Figure 58 - Rock Falls

11.3.11 Also during the experiment, an instance of the CAP/Atom Message Generator was run remotely (from Ottawa) to simulate the output of the Langley Emergency Operations Centre. This message pack was run in and consumed by BCeMap for presentation and the state of the highway and Langley hospital was used in the vignette dialogue at the PREOC.

11.4 Vignette 4: Experimental Findings

11.4.1 **Technology findings:** The experiment was a catalyst for finalizing a feed from Earthquakes Canada to MASAS. A number of challenges were overcome to deliver the feed including conversion of the feed from NRCan to be consistent with the CAPAN CAP Event Location Layer. One issue was encountered relating to the repeating information block in the CAP-CP message to carry the French version of the Earthquake alerts. The repeat elements caused a script to fail in BCeMap and it was not possible to fix and promote the code through the environments in time for the experiment, so for the actual experiment fall back to the simulation was used.

11.4.2 There were a number of environment and delivery issues with BceMap. These are documented in Appendix A, but were overcome in time for the experiment.

11.4.3 One other issue with BCeMap as currently implemented is that the update period is set to one hour. If live feeds from sensors, and a Tsunami warning generation application is implemented, then that refresh rate will be insufficient for the type of information being displayed (i.e. that needs to be much more-real time).

11.4.4 The use of the CAP/Atom Message Builder tool was extensive during this part of the experiment, and went through a number of iterations as the tool was tested and the user interface was refined. Features that were added that made the tool more useable than the early versions included:

- The ability to bulk reset all the messages in the scenario (ready to run the scenario again)
- The ability to bulk update the expiry dates and times on all messages in the scenario. This was used to set the messages up to drop off automatically after each test run so that the hub did not need to be flushed or for the the messages expired manually by hand.
- The ability to change and save scenario names (as their purpose evolves).

11.4.5 Other features of fixes that have been added to the open source contribution since the experiment that are making the tool more-user friendly include:[10]

[10] Source: Darrell O'Donnell

- Times – there were problems with saving and restoring messages – timezone offsets lost the UTC delta on save and on restore, and crossing midnight was faulty.
- Entry support – enhanced support for MASAS Entries (i.e. messages that don't have accompanying CAP-CP message constructs as they are informational rather than alerting in nature)
- Map Integration –a basic map control has been added in that makes defining points and polygons easier.

11.4.6 **Process findings:** A number of the types of alerts or pieces of information that we were presenting in BCeMap did not appear to contain an event type in the event list, most notably the output of any sensors e.g. strong motion ground shake sensors, or seismic bridge sensors, and also the status of each municipalities' EOCs, declarations of emergency or evacuations. It is understood that these may not be handled as alerts and more as 'entries' however there needs to be a standard symbol set that can represent these items.

11.4.7 Through the course of experiment development it became apparent that a major earthquake results in a very large number of actual earthquake events (large and small aftershocks, scattered around the seismically active areas) and therefore the readings from the seismic sensors would be output in a continuous succession and therefore be somewhat difficult to interpret for users that are not familiar with the reading outputs. The representation used in the experiment was relatively simplistic and did not deal with the realities of making such outputs more useful

11.4.8 More sophisticated scenarios could be run if the CAP/Atom Message Generator tool had an update capability, however the create message function in the tool was certainly sufficient to create enough messages for a basic scenario and realistic backdrop to the experiment.

11.4.9 For an event as large as the Cascadian Subduction zone, it must be understood that there would be a very large quantity of information being generated and the more that can be captured and presented automatically without human intervention the better, potentially with links through to other websites containing more details and explanations of events and the data presented. During the execution of the experiment the use of BCeMap to gain an overview or areas affected, EOCs activated, roads closed, Tsunami effects and aftershocks, locations and magnitude proved effective for the operational staff and allowed immediate visualization of the situation.

11.5 Vignette 4: Recommendations

11.5.1 It was recommended that a more formal release planning process would be put in place to avoid a repeat of the deployment issues encountered prior to the experiment. A workshop to define this was held between GeoBC, Citizens Services, Client Services Natural Resource and facilitated by Planetworks and actions agreed, including revisions to the documentation, planning steps added to the delivery process as defined in the table below.

Agreed project delivery process		
Steps	who	Description
Change definition meeting	Called by and arranged by PM (ESRI/Planetworks)	Identify services to be changed, ensure any changes to delivery process is understood
Pre delivery meeting	Called by and arranged by PM (ESRI/Planetworks)	Confirms checklist of items to be working prior to delivery, e.g. accounts, services etc. clarify roles and responsibilities and timelines.
Notification of environment ready	Citizens Services	
Delivery	ESRI/Planetworks	FME scripts can be pre tested, and then packaged as part of main ESRI delivery.

11.5.2 As a result of the experiment it is also recommended that the following improvements are instigated for the tools:

11.5.3 For the CAP/Atom message generator the following additional enhancements are recommended:

- Multi language support

- Ability to set-up and run alert updates (including alert changes and alert cancels)
- Some user checks for when publishing messages that have an expiry date in the past
- Some tidy up in terms of the user interface, size of fields etc

11.5.4 The CAP/Atom message generator tool has been developed as an open source tool and, as mentioned above some work has been performed on the version generated by this CAUSE project to support subsequent usage by the MASAS National Infrastructure Team to add a basic mapping control. However there is some work to be done to clean up the code and make additional features that have been implemented ready for more public release to the MASAS development community.

11.5.5 For the MASAS online tools, it would be useful to provide the hub administrator with the ability to “flush” the hub i.e. delete all messages on the hub at a given instance. This would save considerable time resetting the environment after running in test data, and reduce the effort needed to make sure message pack expiries are set for predicted reset times.

11.5.6 It is recommended that the MASAS event types are augmented with a “sensor output” type perhaps under the “other”, or “infrastructure” group categories. Providing an XML tag would allow users to filter in or out such items. When the response comes from an automated system, such as a sensor, the title and description copy should clearly indicate to the observer that they came from an automated process and not a person. Additionally, give that this information has to be validated the alert or entry should indicate a low level of certainty.

11.5.7 It is recommended that a study is undertaken between the Ministry of Transportation, UBC and Emergency management regarding an effective way to use the seismic sensor outputs to deliver useful information in the context of the large amount of triggered events that are likely in an earthquake, and to determine how that might by pushed to MASAS and presented in the tools such as to BCeMap. One of the proposed outputs from the SIMS system is an isoline or contour map of ground shake intensity derived from the sensors. If this could be pushed to BCeMap e.g. as a time series of WMS snapshots (relating to the most significant aftershocks), showing where the most intense shaking has taken place over the several hours/days after a major earthquake. Alternatively each sensor could have a link to a web site with a timeline of shaking intensity and links to the contour maps that way. As above, models should indicate low level of certainty when automated as a posting. A person in the loop can raise the certainty upon review.

11.5.8 In terms of the BCeMap refresh rate issue, it is recommended that the longer term solution is to upgrade BCeMap to the latest Flex viewer and use the MEFT tools (that do not rely on the current BCeMap Cache and therefore to pull information in real time off the MASAS Hub). In the mean time however there should be some experimentation with reducing the time interval between the FME script runs in the scheduler and investigate optimizing the process to run perhaps as frequently as every 5 minutes (if the scripts can be tuned to run with in that period). If there is an issue with running the scripts sequentially (i.e. the time taken is too long) then it is understood that separate FME processes can be run in parallel at the same time to speed up the process. Another suggestion is to give a clear indicate on screen when the last update was made e.g. a timer station minutes and seconds since the last update.

11.5.9 A symbol set for the information update events are needed also, so that the user can see what has been updated recently, this needs to be part of the working group suggested in the next vignette (international Emergency Management incident/operations/ infrastructure taxonomy and associated symbology). Two alternatives are being discussed: 1/ use a time feature that shows new items in last x minutes/hours. This could be used to help select information for situation reports and brief replacements at shift changes. or 2/ use the same symbol but with a background inserted if new in last x minutes/hours.

12. Vignette 5: US Transportation Route Investigation - Seattle EOC

12.1 Vignette 5: Introduction

12.1.1 The Canadian portion of the experiment was conducted in parallel with a similar experiment being run at the PNNL labs in USA, who were also trialing their own set of technologies for this experiment. The list or technologies they were using is detailed in their project report: See Reference [1]. However it was the intention that at least two technologies would be part of the interaction with the experiment conducted in Vancouver. These were intended to be 'Livewall' and SAMapper.

12.1.2 Livewall was ultimately not operational for reasons described below, however SAMapper was used to capture several pictures and events of traffic incidents in the Seattle area and used in their briefing to the SW PREOC regarding the state of highways in the US. The SW PREOC was able to see both the SAMapper application, and also the events appearing in BCeMap, as an interface from SAMapper to MASAS/BCeMap was implemented.

12.1.3 The Android mobile device software was also demonstrated, where an image from one of the Canadian venues was taken and posted up to the SAMapper dashboard, which could then be seen in BCeMap.

12.1.4 The wider process of identifying potential applications for integration between the Canadian and US parties, leading to this vignette is described in Section 5.5.

12.2 Vignette 5: The Technologies

12.2.1 Livewall was a video conferencing system that is designed to allow users in multiple rooms to share a video and interactive desktop session using a touch sensitive, stand mounted, large screen that had a transparent overlay of the desktop over the video content such that both could be seen at the same time. Interaction between 'rooms' could be both voice, video and informational content at the same time. It was intended to use this technology to support an interactive dialogue between the SWPREOC and the PNNL laboratory and the discussion around the state of the highways around the Seattle area.

12.2.2 The Livewall components for the SW PREOC (screen, stand and Minimac) were delivered to Vancvouver by the PNNL project team and installed, using the SFU link to the internet via the microwave radio link via the SFU campus. This took some setting up (ensuring firewalls, ports and network connections were available, and this did work, but with some intermittent issues regarding the video sessions that involved logging off / shutting down and rebooting components, Other tests showed a fault with the microphone noise cancellation at the Seattle end and the delay on the voice was up to half a second (causing communication to be a little stilted). Before the experiment was executed the hard disk on the Minimac was lost and could not be recovered so the Livewall product was unfortunately not operational for the experiment and the dialogue focused on a telephone based call.

12.2.3 The other technology called SAMapper (short for Situational Awareness Mapper) was built by a PNNL development team on Google's application infrastructure (appspot.com) and features the ability for mobile devices such as Android phones to take photographs of incidents, events or damage, and for those pictures to be labelled with some information and pushed into the application dashboard.

12.2.4 In the experiment, a number of images were pre-loaded into SAMapper by PNNL for the scenario (for all the incidents around Seattle), but also a copy of the Android SAMapper smart phone application was shipped to Vancouver and loaded on a phone being used by one of the experiment coordinators at the City of Vancouver Emergency Operations centre. During the initial briefing for the day a picture of the Vancouver EOC was taken with the phone and posted to SAMapper (see image in the next section). This was done to demonstrate the capability and was not part of the scenario.

12.2.5 A modified version of the CAP/Atom Message Generator was implemented that was able to call a web service on SAMapper to pull all the current messages, drop them into the message generator and re-publish to MASAS. This was manually initiated but represented the essentials of an integration service that would allow such tools to republish messages into the MASAS infrastructure and be consumed by any other tool that can draw from MASAS. This represented the first cross-border experimental interchange of alert messages using MASAS, illustrating the ease with which technically these components can be integrated.

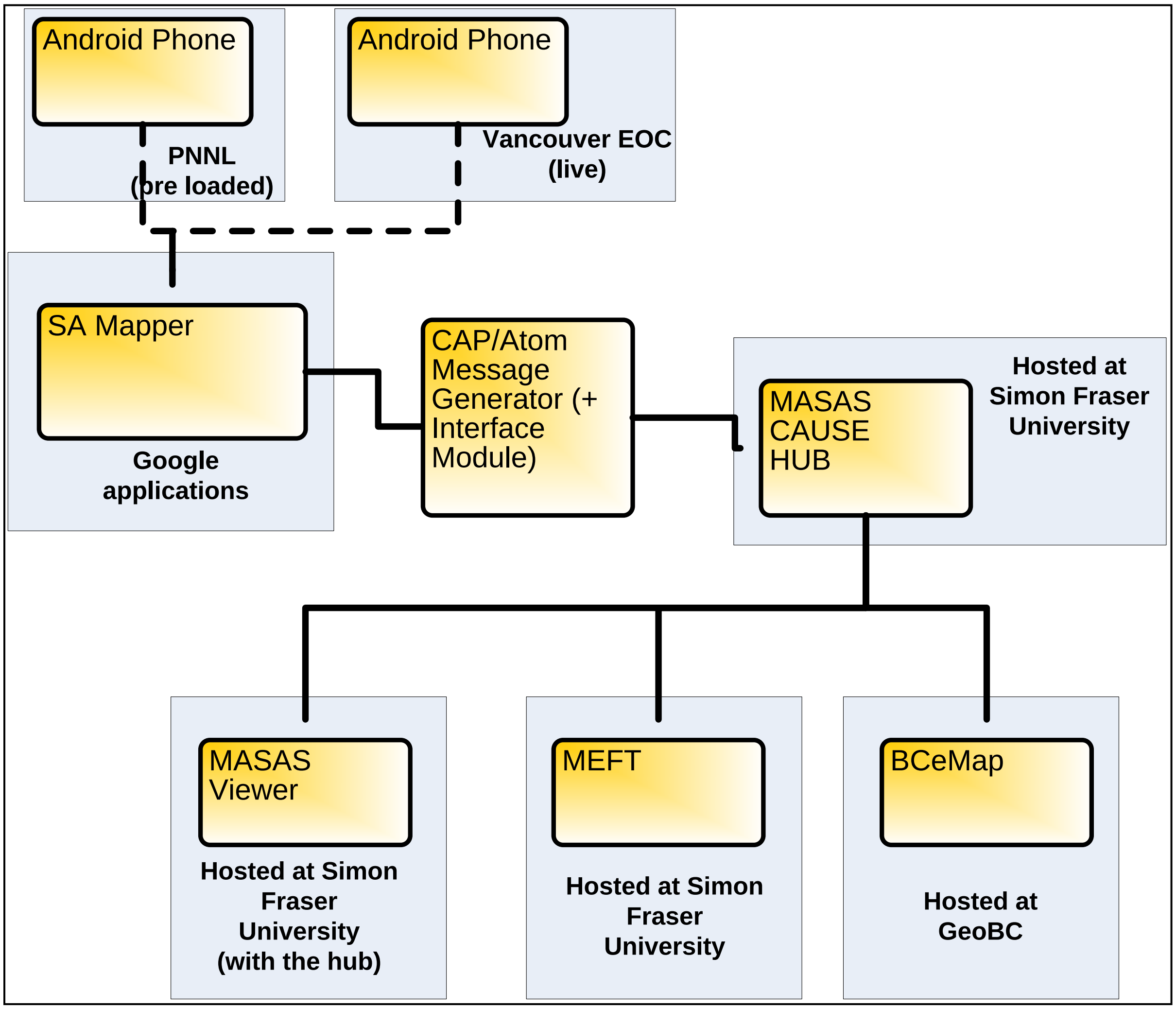


Figure 59 - SAMapper Integration with MASAS

12.3 Vignette 5: The Action

12.3.1 During the briefing between the SWPREOC and the Seattle Emergency Operations Centre (as played by the group at the PNNL laboratories), SAMapper was used to give an update of the situation on the highways and immediate vicinity of Seattle.

12.3.2 The events and images in SAMapper were available via the SAMapper screens, and also via the MASAS interface into BCeMap. When Seattle were giving their brief the same information was on screen at the SWPREOC (in both SAMapper and BCeMap).

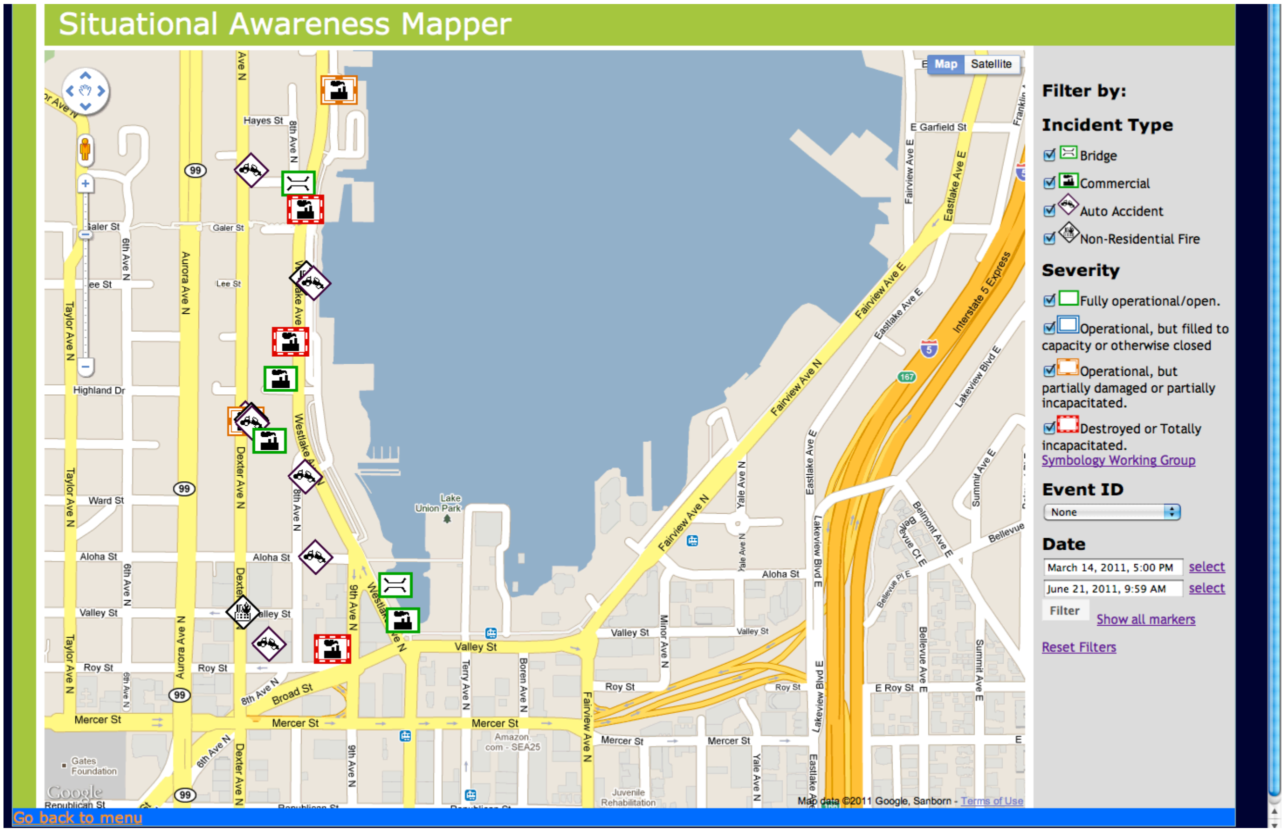


Figure 60 - SA Mapper Dashboard.

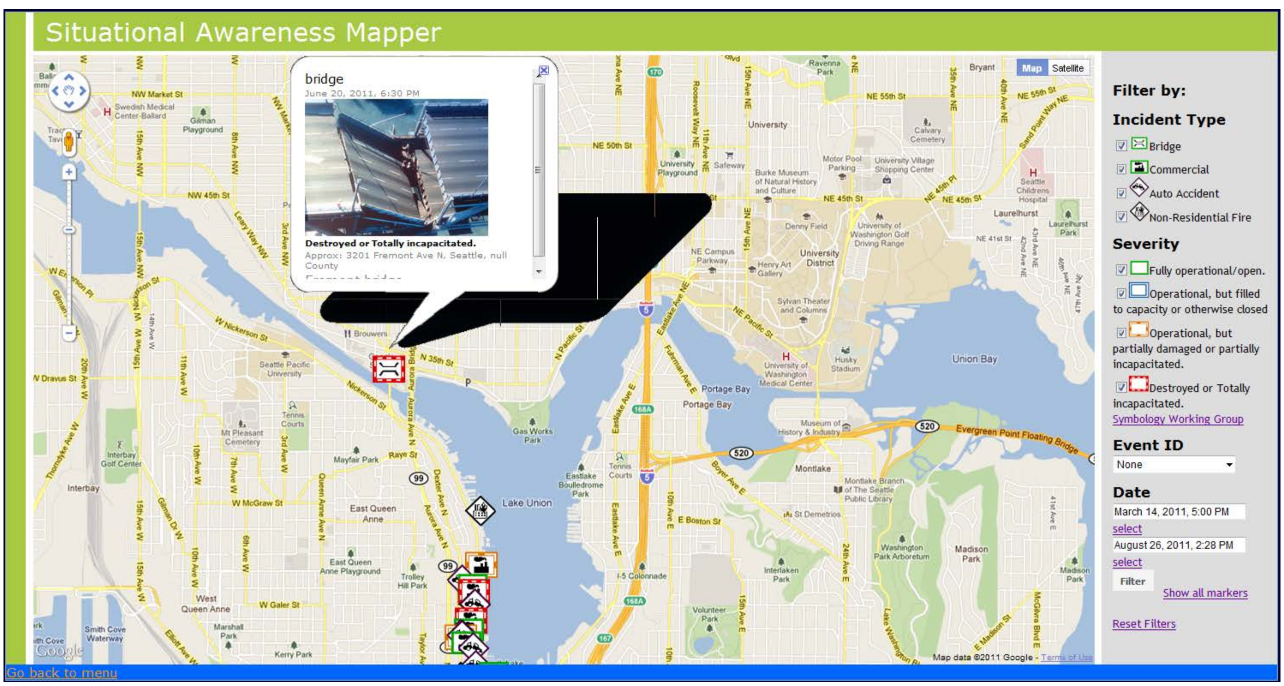


Figure 61 - SA Mapper event Image Pop-up.

12.3.3 The following images are the same events as they appeared in BCeMap, having been pulled from SAMapper by the message generator add-on and then republished to MASAS.

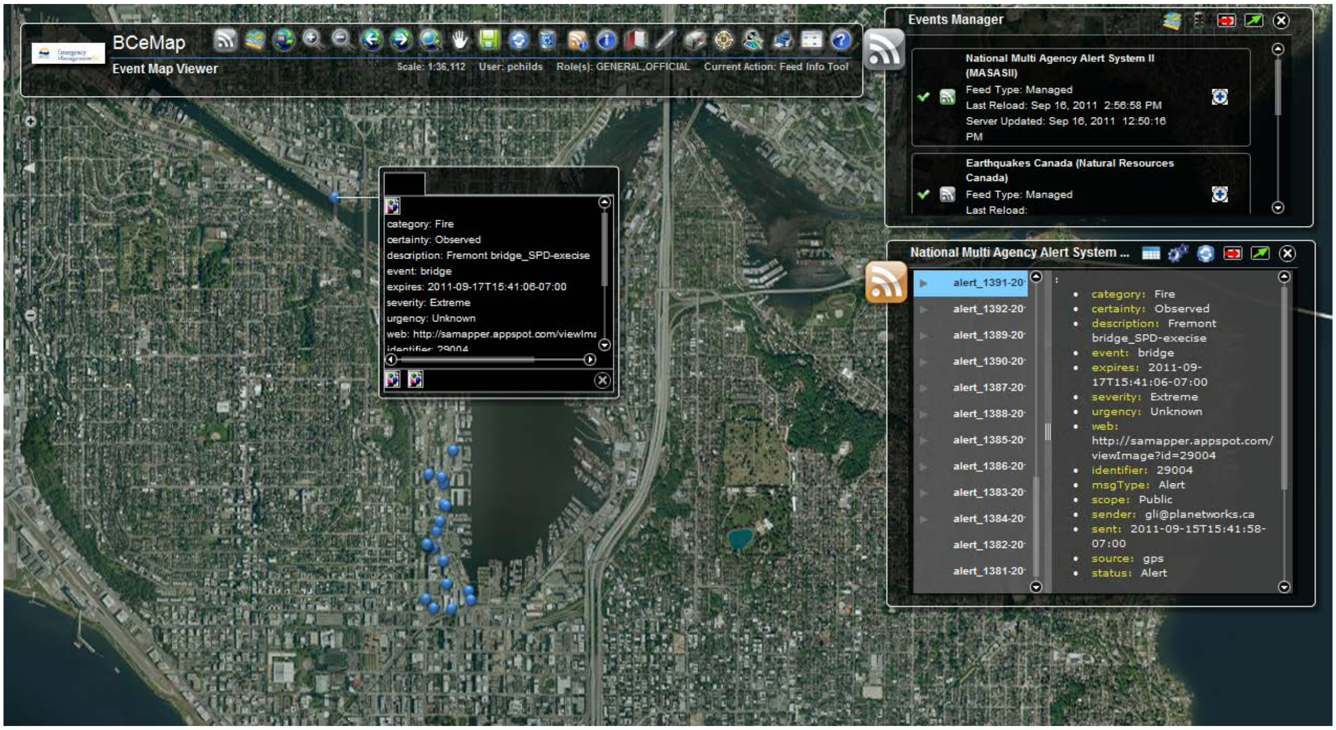


Figure 62 - SAMapper Image in BCeMap

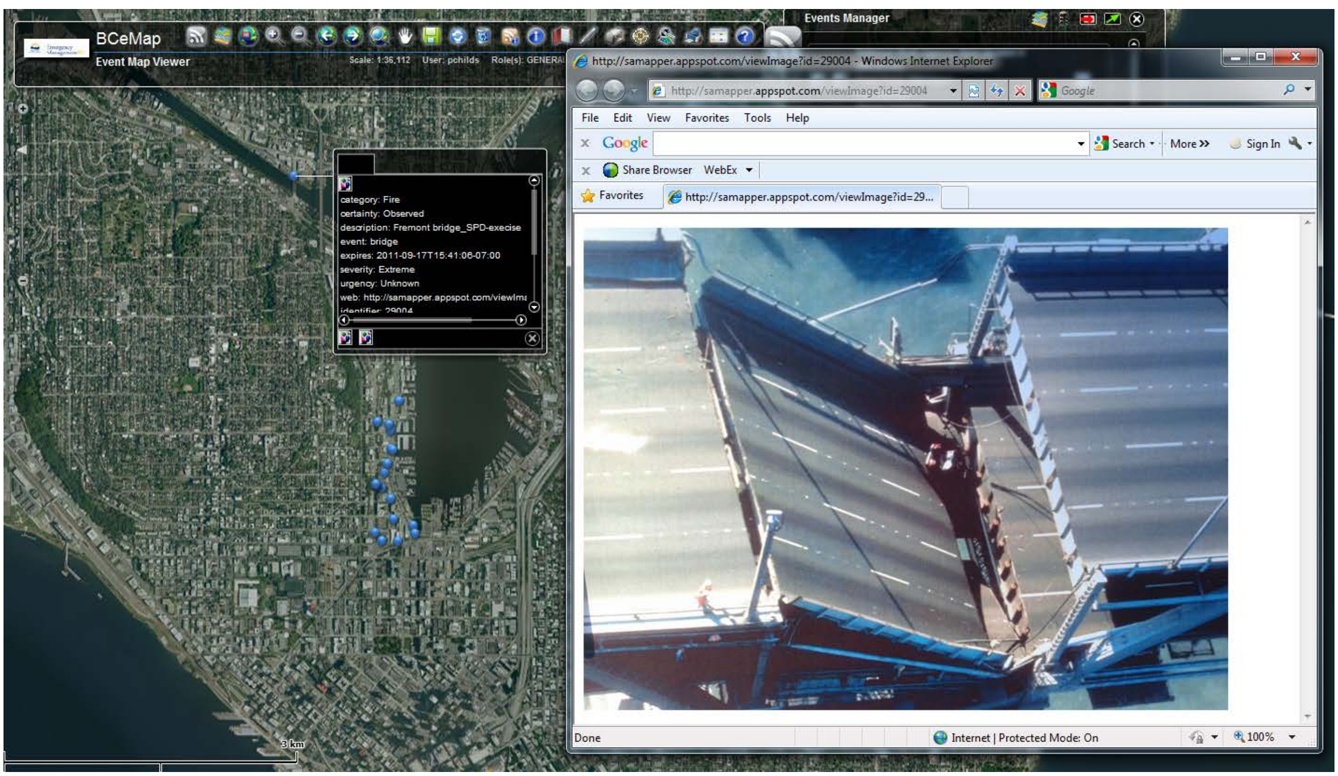


Figure 63 - SAMapper event with Bridge Image

12.3.4 The Seattle EOC reported that although there were several impacts in the area and this particular bridge was collapsed, the major highways were passable. The Seattle EOC was asked if they knew of the state of the highways north towards the border, but they advised that Whatcom county or the state should be contacted for that information – this set the scene for the next vignette.

12.3.5 Separate to the main action, and just as a demonstration of capability the following image was taken at the Vancouver EOC via the Android application on one of the experiment coordinator's Android phone:

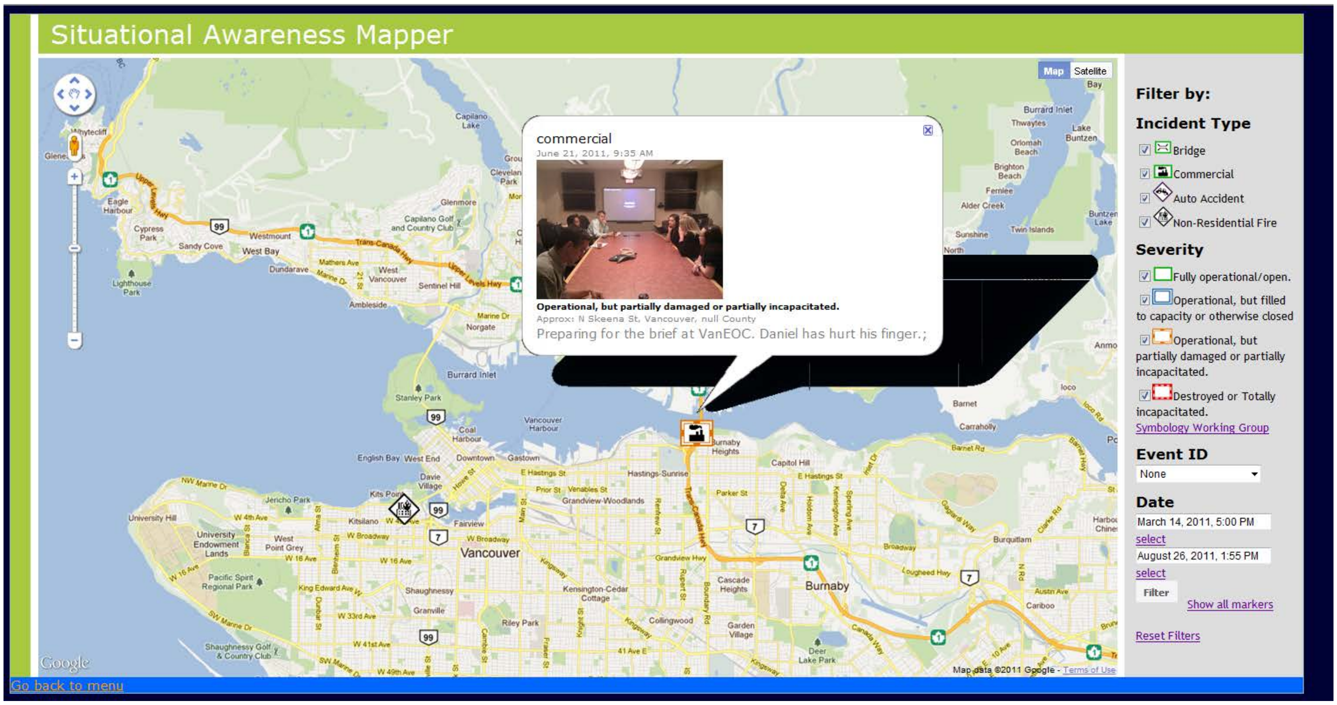


Figure 64 - Vancouver EOC briefing room image

Figure 65 - Image from Vancouver EOC – note: Daniel's thumb is all better now.

12.3.6 Again, this report was available through BCeMap once it was pulled from SAMapper and pushed to MASAS/BCeMap. See Figure 66

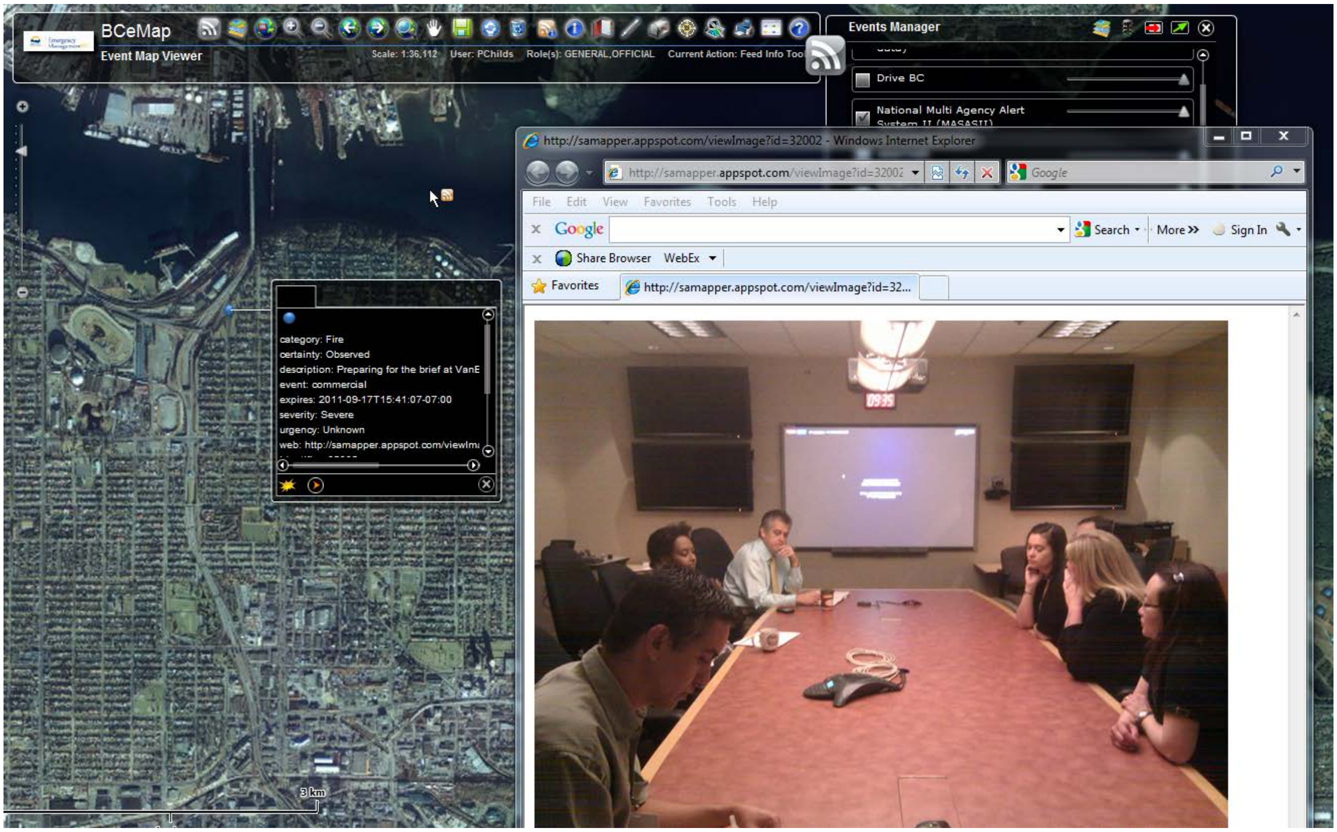


Figure 66 - SAMapper Event from Vancouver EOC in BCeMap

12.4 Vignette 5: Experimental Findings

12.4.1 Livewall was initially well received when installed at the SW PREOC. A number of the managers were able to see the system in action when it was first set up, and some expressed interest in the possibility of having such systems in all five PREOCs for communication between those locations and the PECC.

12.4.2 The teething troubles that were experienced revealed that the product lacks maturity in terms of handling the various issues experienced. In particular the potential network capacity, latency and packet loss performance will always be an issue between remote locations, and there should be diagnostic or error handling capabilities that would let the users or system administrators know what the problems might be if the system is not performing as expected (e.g. video or audio streams not present, as was experienced).

12.4.3 The SAMapper application proved to be extremely simple and quite effective for a mobile device reporting and dashboard tool. The application to generate reports on an Android phone installed easily and worked well, and it was a matter of a few hours development to implement an interface to MASAS, albeit the code used for the experiment was not production quality and lacked security. Proper mapping between the SAMapper codes and the MASAS codes would also be required.

12.5 Vignette 5: Recommendations

12.5.1 SAMapper might be considered as a low cost option to facilitate reports from smart phone users in the field. Further investigation would be required into the overall security of the application and operational procedures around capturing, classifying and retaining images. The devices carried by any target field user group would have to be assessed and whether their devices are supported. The solution could be evaluated against use of Ushahidi for the same purpose.

12.5.2 It was demonstrated that it would be technically feasible for systems in the US to be connected directly (via an adapter) to MASAS. However, as US systems become connected to IPAWS, the US national messaging solution, as detailed in the next section, it makes more operational sense for Canadian systems to receive messages from US systems via IPAWS and MASAS, otherwise duplicate messages will be received.

13. Vignette 6: US Transportation Route Investigation - Washington Emergency Management Department

13.1 Vignette 6: Introduction

13.1.1 In this vignette, having established the state of the highways around Seattle and that they are passable, the Operations Director at the South West PREOC determines that it is necessary to discuss the state of other highways running East-West across the state and North-South immediately below the border. This was to determine if the highways might allow passage of resources from Osoyoos down into the United States and back up into Canada).

13.1.2 A dialogue therefore takes place between the SW PREOC and the Washington State Emergency Management Department (WA EMD) Emergency Operations Centre that is located on Camp Murray near Tacoma.

13.1.3 This dialogue was recorded subsequent to the main experiment day by telephone, and recorded using a conference bridge with the film studio.

13.2 Vignette 6: The Technologies

13.2.1 To support this dialogue an interface between official United States and Canadian alerting message infrastructure was established as illustrated in Figure 39. i.e. an interface from an instance of the MyStateUSA system in the states, through IPAWS to MASAS and then to BCeMap. These components are described in more detail in section 6.

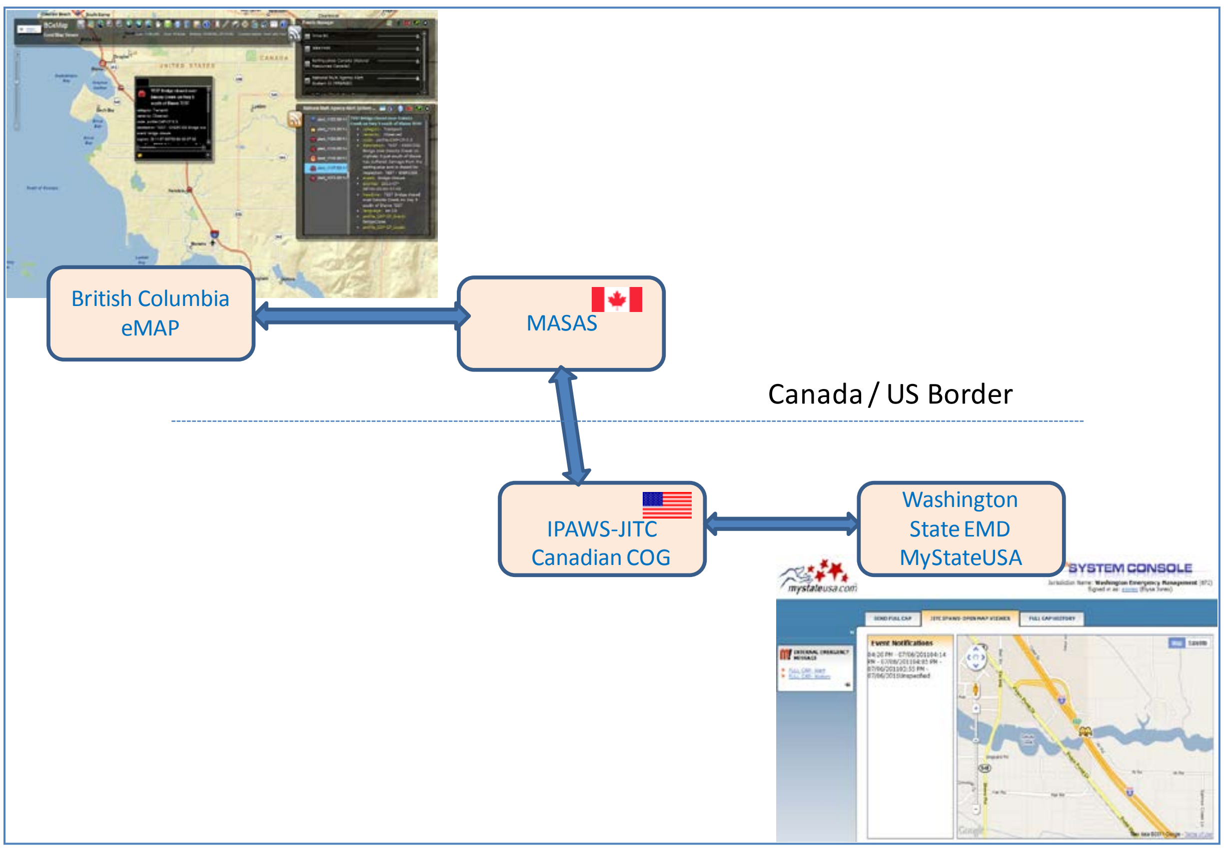


Figure 67 - US/Canadian alerting infrastructure connection

13.2.2 The Joint Interoperability Test Command JITC (JITC) is a division of the Defence Information Systems Agency that supports the FEMA Integrated Public Alert and Warning System (IPAWS) program. This group tests the interoperability of alert and warning equipment, and they provided access to a test instance of IPAWS for the purposes of the experiment.

13.2.3 A Common Operating Group (COG) specific to Canada was created such that test messages could be received from and pushed to IPAWS by MyStateUSA and the messages could then flow to and from the Canadian MASAS hub

using addressing specific to that COG.

13.2.4 To develop the interfaces illustrated in Figure 67, the developers at MyStateUSA worked to build interfaces to the IPAWS-JITC instance to both publish and consume messages. In parallel the MASAS National infrastructure team implemented a VPN connection to the JITC-IPAWS instance and implemented code that was able to move messages between JITC-IPAWS and MASAS. Due to time constraints, there were still manual elements to this process (i.e. initiating a push or a pull between the hubs) but the mapping and translation of messages and codes for the sample set of messages was set-up and the ice was broken in terms of international alert messages. The technical details of the set-up were as follows.

13.2.5 Connecting to MASAS was secured via an HTTPS connection that could be made from any internet connected host. MASAS employs a REST API based on AtomPub to send/receive information. Connecting to JITC-IPAWS was secured via a Cisco software VPN system. JITC-IPAWS employs a SOAP API with specific header and message body handling to send/receive information.

13.2.6 Software was created to automate the sending and receiving of information for both systems. The MASAS script provided the ability to download any Entries that had been posted in IPAWS since an entered time value and deposit them into a directory as individual CAP messages in MASAS. In addition to downloading these messages, the script also had an upload function that could post an individual CAP message to MASAS. The JITC-IPAWS script had very similar functionality to both download and upload individual CAP messages.

13.2.7 In order to fully bridge the two systems some manual steps were necessary. Once a message was downloaded from JITC-IPAWS, and prior to uploading to MASAS, some changes to the CAP message were necessary. An attempt to add CAP-CP Profile elements in place of CAP-IPAWS to the messages was being made by MyStateUSA, however there were still CAP-CP issues which would have caused rejection of the message. These errors were corrected manually. Values for <event>, <eventCode>, and <geocode> were changed. Once these changes were made, the MASAS script was employed to post the message.

13.2.8 After downloading a message from MASAS and prior to uploading to JITC-IPAWS, changes were also necessary to the CAP message. Due to the fact that JITC-IPAWS was still in development, different changes were required depending on the day a posting occurred. Typically the changes involved removing all CAP-CP Profile elements from the message and adjusting the <sent> and <expires> time values to meet the very stringent requirements that JITC-IPAWS imposed. Once the changes were made, the JITC-IPAWS script was employed to post the message.

13.2.9 Development of the MASAS and JITC-IPAWS automation scripts was relatively quick, based on the documentation provided. A serious challenge was posed by the VPN system used to secure JITC-IPAWS however, which prevented any testing of the JITC-IPAWS script against a live environment until a few days prior to the live event. The VPN software used an older SSL certificate that many modern browsers considered too old and insecure to be valid and so rejected any attempts to connect. After some experimentation a custom Windows XP build was created to connect to the VPN, however once successful connections were made, stability problems were encountered with the VPN dropping the connection at random times. Due to these VPN issues, not enough testing took place beforehand to provide the feedback MyStateUSA required to fix the CAP-CP issues, nor to work on an automated method to correct the messages as part of the exchange, and so a manual method was adopted.

13.2.10 JITC-IPAWS was also being actively developed at the time and was not a stable system. During some test runs early on, CAP-CP Profile messages were accepted. However later attempts to send CAP-CP messages were rejected. The error messages provided by JITC-IPAWS were sometimes cryptic and difficult to understand which made diagnosing these errors time consuming.

13.2.11 The eventCode list used by the CAP-IPAWS Profile also posed a challenge. It is a very limited set of events and does not translate well to CAP-CP events. While the geospatial elements of CAP, polygon and circle, resolved any translation issues between different geocode elements used by the two CAP profiles, there is no universal translation for eventCodes.

13.2.12 The scenario was developed around some specific incidents in the Northern end of the states on the I5 at Ferndale, Dakota Creek and at the border crossing. Similarly the events just north of the border were transmitted to MyStateUSA i.e. an industrial fire in White rock, traffic congestion on the Alex Fraser Bridge and the closure of the Massey tunnel.

13.3 Vignette 6: The Action

13.3.1 The images of the events in the respective systems are as follows. Figure 68 shows a screen in MyStateUSA for a message sent from MyStateUSA and the map representation in Figure 69.

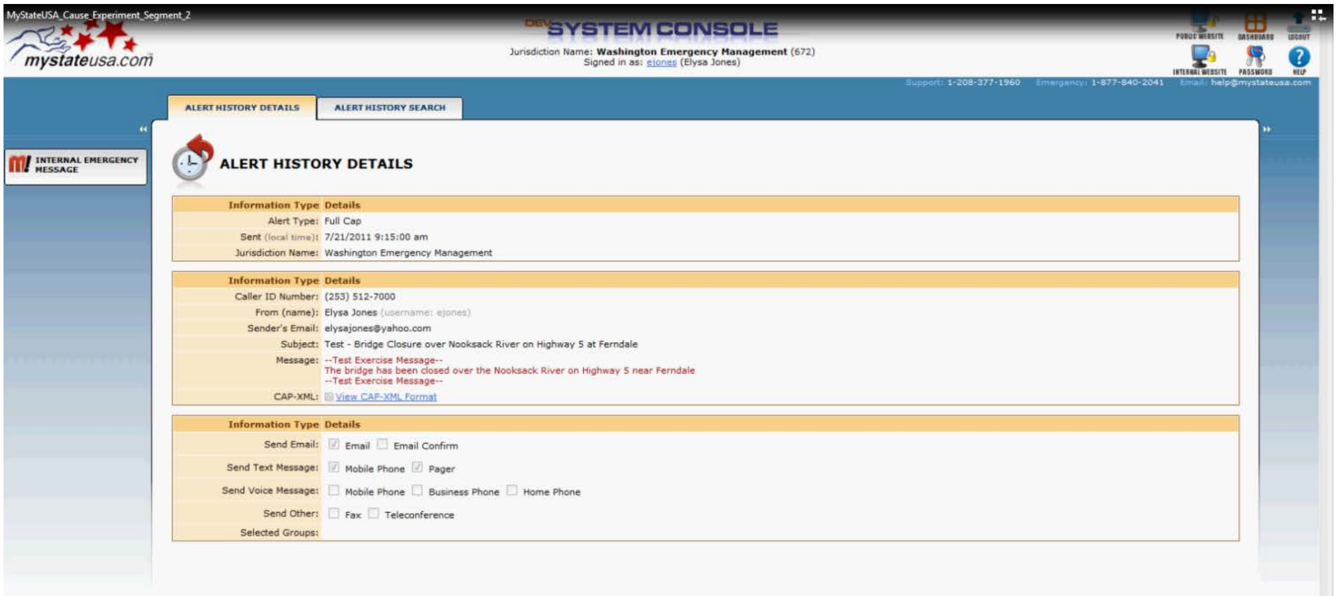


Figure 68 - Message sent from MyStateUSA

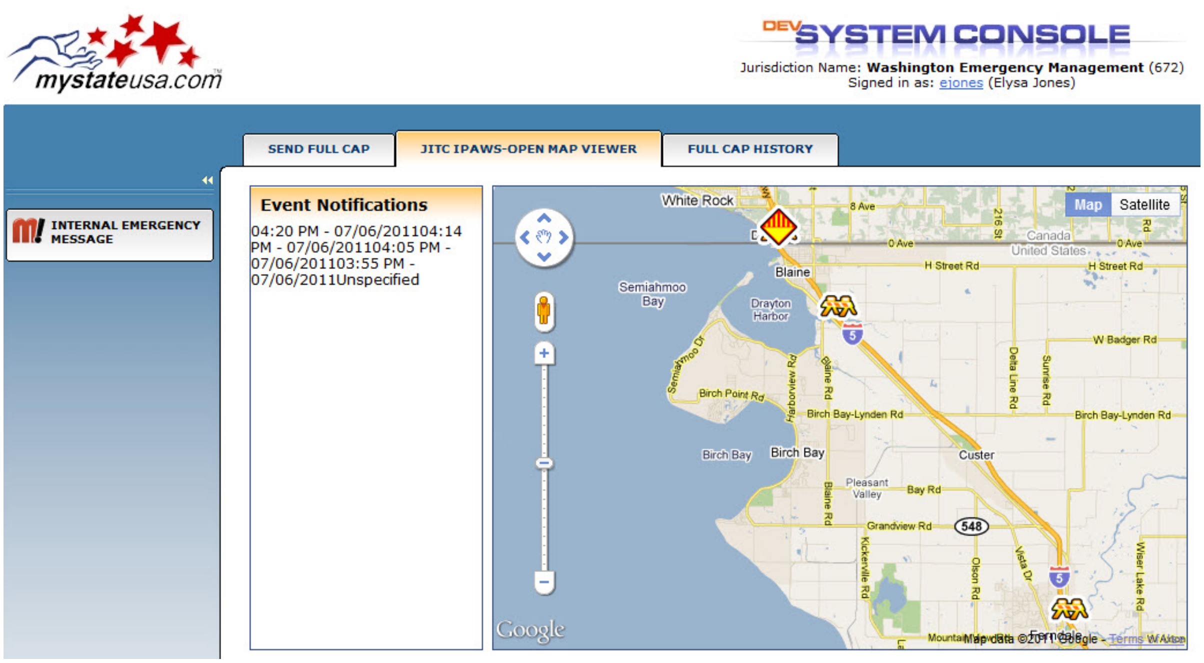


Figure 69 - Map view of Messages sent from MyStateUSA

13.3.2 Their representation in BCeMap (once they are sent from MyStateUSA to IPAWS to MASAS and then to BCeMap is shown in Figure 70.

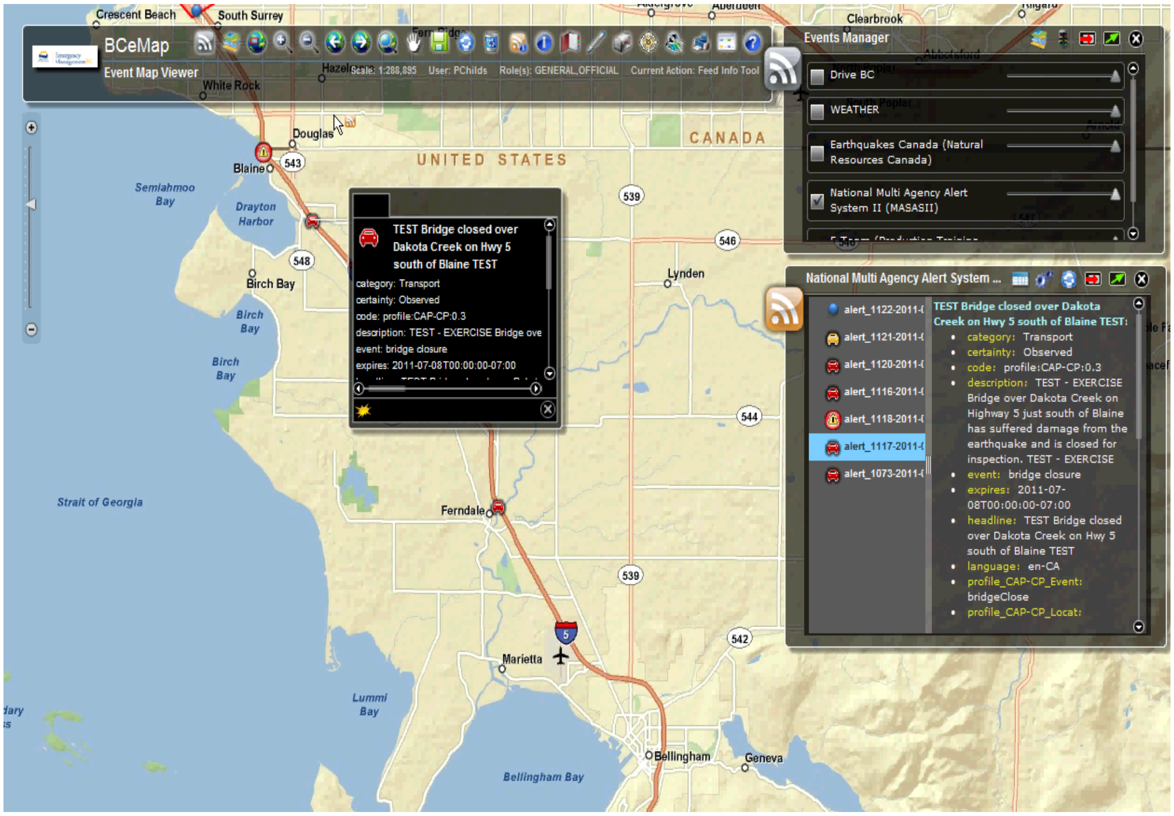


Figure 70 - BCeMap representation of alerts from MyStateUSA

13.3.3 The screen in Figure 71 also shows the messages sent from BCeMap to MyStateUSA (the messages North of the border, including the closure to the Massey Tunnel, traffic congestion on the Alex Fraser bridge and the industrial fire in White Rock:

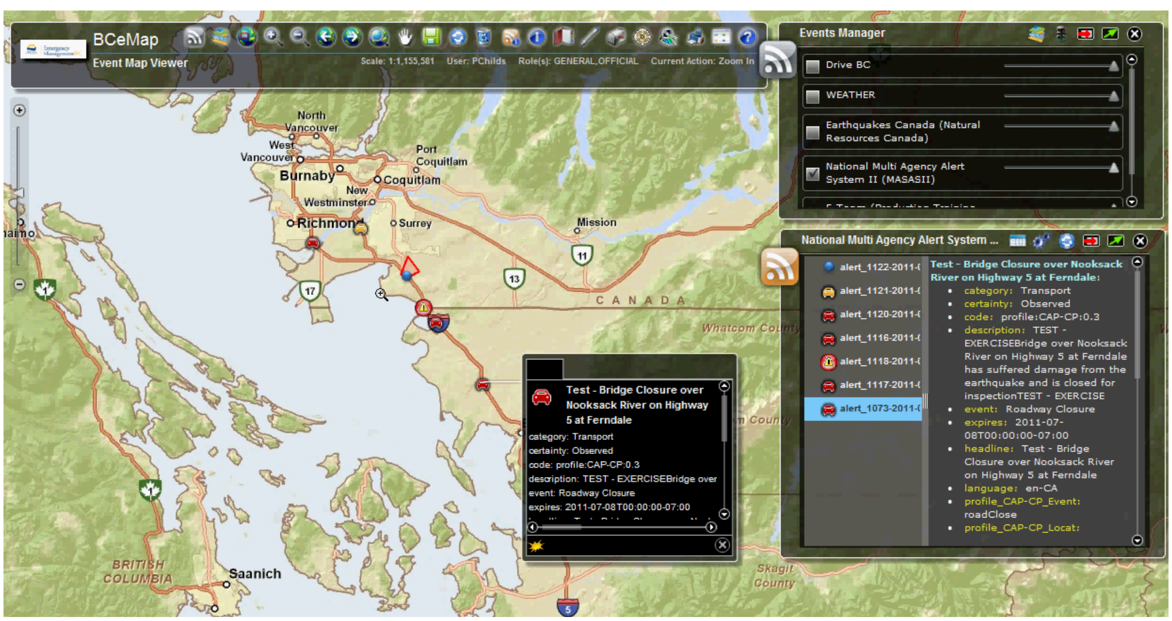


Figure 71 - BCeMap view of Messages sent to MyStateUSA and received from MyStateUSA

13.4 Vignette 6: Experimental Findings

13.4.1 Support for this vignette was strong from the participants, and there was some excitement about seeing alert messages pass between the two official alerting hubs of the countries for the first time. This was a considerable achievement considering the technical and political hurdles that were overcome.

13.4.2 The ability for neighbouring agencies to be aware of the state of highways and incidents at any given moment without the need for a formal situation report (and all the filtering that process involves) or direct telephone communication with the right individuals, was deemed enormously powerful, especially between areas that are geographically very close, but politically and organizationally very separate.

13.4.3 The original plan at the US end was to use the production IPAWS-OPEN platform however; FEMA IT would not allow foreign access citing DHS security rules. An equivalent implementation of IPAWS-OPEN which resides at the JITC was used for the development, testing and execution of message exchanges during the experiment, consistent with use of test instances on the Canadian end.

13.4.4 The MyStateUSA team identified what would be needed to implement the symbology and profiles fully in the MyStateUSA system. However time schedule and resources were not available to complete a full implementation of this for the experiment. However, forms were developed for the specific messages needed for the exchanges. MyStateUSA has determined that they are prepared to fully implement the CAP-CP, event location layer and Canada symbology if required by subsequent projects. The company's management is committed to allocate resources to make this upgrade as they value the opportunity to support the sharing of data across international borders using open standards. [11]

13.5 Vignette 6: Recommendations

13.5.1 It is recommended that a project, or projects are established to engage working groups that span the border to develop the governance, operational procedures, technology, training/exercises and real usage[12] that would allow alerts to cross the border. These projects should consider what systems generate messages, under what context, what do they mean to whom, and what mappings are required between the codes in different systems.

13.5.2 A number of cross border pilots are being planned, several involving NIEM messaging to police the relevant information sharing, and at least one pilot that might involve sharing bio-alerts on health related outbreaks (e.g. H1N1, SARS etc.). Other areas of interest to the DHS S&T sponsors of this project include suspicious activity reports involving movement of cash across the border or human trafficking.

13.5.3 These projects should include some elements aimed at implementing pilot operational integrations, for example a production version of the MyStateUSA (implemented at WEMD) to BCeMap connection, via production versions of IPAWS/MASAS. The project could also look at technical issues in terms of how the use of CAP with EDXL-DE[13] (i.e. EDXL-DE as a wrapper for CAP) could be used to make it NIEM compliant and could be used to better manage distribution of feeds coming north into Canada and vice versa.

13.5.4 The project above should be established to work with the senior execs and similar project initiatives at FEMA IPAWS, NIEM PMO (National Information Exchange Model Program Management Office) and the PM ISE (Program Manager for the Information Sharing Environment) organizations.

13.5.5 It is understood that this CAUSE project has raised the profile of this initiative and the security obstacle with FEMA IT has been resolved. A stipulation in one of the Policy documents has been re-interpreted such that interface with another nation can be allowed. The experiment broke the ice but policy hurdles remain.

13.5.6 A Memorandum of Understanding (MOU) was agreed with the US counterparts to demonstrate the MASAS<> IPWAS connection. Two other MOUs have also now been signed to progress the technical and operational aspects of the connection. High level governance needs to be addressed in terms of a master working group that can provide governance, monitor and coordinate between the cross border pilots, ensuring consistent approaches and can address an international EM incident/operations/ infrastructure taxonomy and associated symbology.

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[11] Source: Summary report of project involvement from Elysa Jones (Alert Sense consultant).

[12] Governance, Standard Operating Procedures, Technology, Training/exercises and usage are the Interoperability Continuum Elements promoted by the DHS Safecom program to assist agencies and policy makers to implement interoperability solutions.

[13] EDXL-DE stands for Emergency Data Exchange Language - Distribution Element. An OASAS standards track describing a standard message distribution framework for data sharing among emergency information systems

13.5.7 Further development of the IPAWS/MASAS interface should be included in the next experiment.

13.5.8 While the exercise involved simulated information, MASAS/IPAWS experiments exposed CAP quality issues from the U.S. National Weather Service that we understand are being worked on.

13.5.9 In order to provide an operationally ready exchange of information between MASAS and JITC-IPAWS, further work is necessary. The JITC-IPAWS interface needs to reach a stable level, both in the method used to secure the connection to the system, i.e. preferable a redundant private IP network connection, not a VPN, and also stability in the methods used to upload and download messages. A key requirement is that JITC-IPAWS should accept a CAP message with CAP-CP Profile elements and any CAP requirements that are being imposed on a system wide basis should not be specific to CAP-IPAWS only. These requirements should apply only if the CAP message is identified as CAP-IPAWS. Messages sent by US systems should not substitute CAP-CP for CAP-IPAWS in their messages destined for cross-border exchange. MASAS supports CAP-IPAWS natively. If a US based system does support CAP-CP, it should publish the message in both Profiles rather than switch between the two.

13.5.10 The MASAS interface needs to develop methods to address messages based on the COG ID's used by JITC-IPAWS. This will be challenging because the addressing of messages is contrary to how MASAS currently operates. Some possible solutions are a subscription based method for JITC-IPAWS systems to identify their COG ID and area of interest, or a general delivery MASAS COG.

13.5.11 Finally the translation of eventCodes between systems needs to be addressed. CAP-CP provides a very detailed list of events while CAP-IPAWS is limited. Direct translation between the two is not possible for many of the events that could take place during an emergency. A likely solution is to expand the CAP-IPAWS eventCode list, or to develop a shared eventCode list that is not Profile specific but can be included in CAP messages to ease translation between more localized eventCode lists.

Appendix A – The BCeMap/MASAS Integration Development Project.

BCeMap is British Columbia's situational awareness and emergency mapping system. Through development funded by GeoConnections in 2009/2010 the system was build by ESRI and hosted at GeoBC on behalf of Emergency Management BC who is the main sponsor. The system is currently in production for use by the Provincial Emergency Operations centres and brings together over 60 static layers together with several dynamic data feeds to present a single browser based map for users, using the state of the art ArGIS flex tools developed by ESRI.

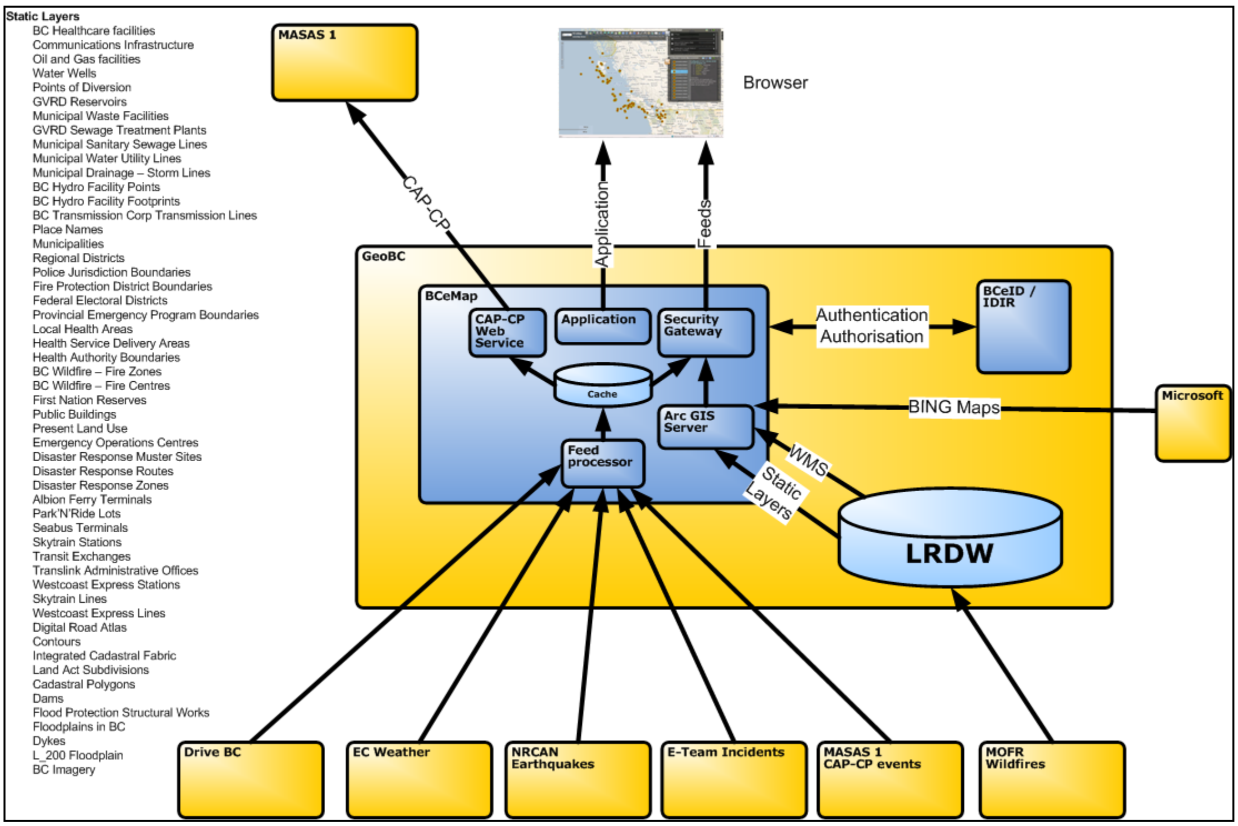

Figure 72 - BCeMap Architecture

Figure 6 shows the architecture of BCeMap, how the static layers and wild fire (from Ministry of Forests and Range) feeds are served up from the Land and Resource Data Warehouse together with feeds from Drive BC, Environment Canada Weather, NRCan Earthquakes, incidents from E Team (the provincial incident management system, and also a data feed from the original pilot version of MASAS (MASAS 1).

Figure 73 is a screenshot of BCeMap showing the earthquakes in the province over a period of several weeks. Most of which are normally less than a Magnitude 2. A few are large but rarely occur near populated areas.

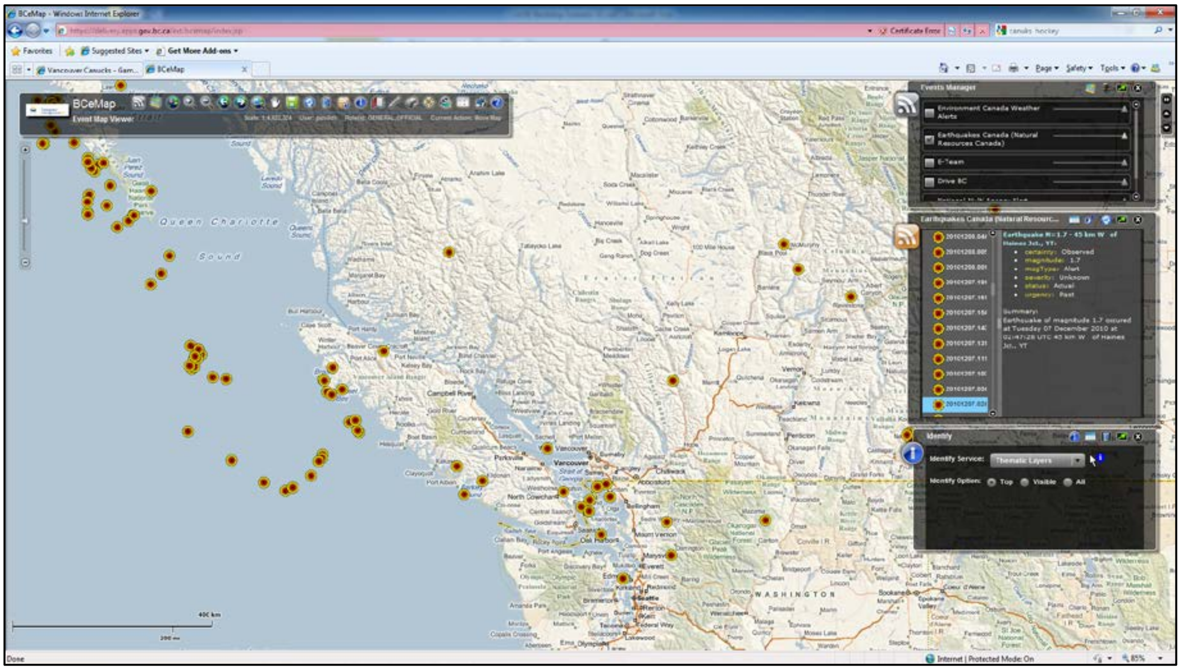

Figure 73 - BCeMap Earthquakes feed.

For the CAUSE experiment, it was determined fairly early on that a change to the newer MASAS II feed was required to enable MASAS II to be the core integration platform for the technologies to be used in the experiment. The MASAS 1 feed was to be deprecated and the MASAS II feed used Atom as the delivery mechanism for the CAP-CP messages. An upgrade was therefore deemed necessary.

Several options were considered for the upgrade, including the adoption of the open source MASAS ESRI Flex Tools (MEFT) developed by the MASAS National Infrastructure Team, for the consumption and publishing of MASAS messages on such a platform. However one significant issue was that the MEFT are build to the Flex Api version 2.2 and BCeMap is still based on version 1.3 (at the client end) and also the server side ArGIS versions would need to be upgraded also. The upgrade of BCeMap to these later versions was costed and deemed too high a cost, risk and timeline to support this approach for the CAUSE experiment.

Therefore a lower cost and lower risk approach was determined i.e. the development of a new FME[14] script to process the MASAS II messages and convert to the standard BCeMap cache format for serving up to the application in the same manner and using the same user interface tools as the other feeds.

Planetworks contracted a developer with FME experience to implement the MASAS II feed. The script was developed on a partial platform at Planetworks (including an Oracle database constructed to emulate the BCeMap database), and deployed to the development platform at ESRI.

ESRI was contracted to upgrade user interface configurations to support the replacement of the MASAS I display with the MASAS II controls. The opportunity was also taken to upgrade the user interface controls to allow filtering of the events on display based on data in the messages such as date of message update, status, event type, and combinations of those data fields, to give users more control of what they see. In addition the zoom controls were changed such that click and double click of the events in the list provided a configurable level of zoom.

These changes were all delivered by ESRI and tested with the new FME script and then packaged by ESRI for deployment on the delivery platform at GeoBC.

A number of issues were encountered at GeoBC with the deployment processes and platforms including:

- some challenges configuring the security gateway

[14] FME is a state-of-the art GIS Extract Transform and Load (ETL) toolset developed by Safe Software for transforming data messages from one format to another and includes the ability to convert data from web service calls to database format. It is used for the other dynamic feeds to convert to the BCeMap Cache.

- some restructuring was required to cleanly separate services between the three hosted platforms (delivery, test and production).
- a separately sponsored upgrade to the security gateway on the delivery platform disabled the application (this was reversed out for the duration of the experiment)
- the failure of the Bing maps token service through ESRI which disabled the base map services
- the discovery that the BCeMap database cache only supported a coordinate range that spanned from a line extended from the Eastern border of Alaska, to the Eastern border of Alberta and from a part of the states just south of Tacoma up to a latitude above the North West territories. This constraint was put in to the BCeMap database when originally deployed to match the Land Resource Data Warehouse standard (which includes milli-metric accuracy and hence this geographic limitation in order for the database server operating system to cope). When the earthquake messages were passed in through MASAS that were further south than allowed, an error would be thrown on the feed supplying the user interface. A temporary filter was implemented in the FME script to prevent the error for the duration of the experiment.

The issues above were resolved, deployment was successfully completed and tested such that all functionality needed for the experiment was in place for the execution date of 21st June.

Test pack messages were generated using the CAP-CP/Atom Message generator that was developed to support the scenarios in the project. Conducting the experiment itself went a long way towards testing the respective tools (both the generator, the FME script and the user interface presentation). A number of resilience issues were exposed regarding the FME script and threes are being corrected as part of the leave-behind for the project (for example resilience to strange characters that can be experienced by users copying and pasting text sections from web pages). This particular fix is also being implemented on the E Team FME feed script which also experiences the same issue. Ability to handle multiple text blocks in MASAS messages is also being added, for example the French sections.

A direct feed of NRCan earthquake messages was attempted in the week leading up to the experiment execution, however there was insufficient time to add the multi text-block handling for the actual execution and these messages were emulated using the CAP/Atom message generator instead.

In addition 2 WMS feeds were implemented from the following sources: an ArGIS server WMS feed of the static layers output by Hazus-MH for the Richmond Cascadian Subduction zone damage assessment and also for the EmerGeo Fusionpoint WMS output of incidents. There were both successful in implementing a visual representation in BCeMap although both sources would need some development work to be fully implement. Such developments would be avoided through use of MASAS for such feeds instead.

Subsequent to the experiment further User Acceptance Testing (UAT) on the event filter tools has also been executed and issues raised on ESRI.

All fixes to the components, and the change to the database cache coordinate range (which has been escalated through change request to the respective authorities in GeoBC) are being scheduled for deployment in late August or early September to complete the CAUSE project leave-behind and close-out the project.

The experiment has shown that BCeMap can be an effective means for information to be brought together and shared with others as part of the general emergency management infrastructure in BC. It is able to pull together information from multiple sources including WMS sources and now all data feeds available through MASAS II.

As more layers are added and as MASAS becomes more enriched with new feed sources (e.g. recently the NRCan earthquake feed and the BC Hydro power outage data overlay) then BCeMap will become more relied on especially as it is rolled out. Currently the application is only available to Emergency Management BC users in the provincial Emergency Operations Centres, however the medium to longer term plan is to make available to municipal jurisdictions.

As dependency increases then it is recommended that the resiliency of this component is increased accordingly. The application is currently hosted out of a single hosting facility in Victoria which is close to the likely areas of seismic activity in case of a major Cascadian Subduction zone event.

One key recommendation therefore is to enhance the resilience of the application to ensure continuity of service. A full Service Level Agreement has not yet been agreed for BCeMap with the hosting organization. It is understood that the current facility is based in Victoria, has 24 hour security, is hosted on servers with dual Network Interface Cards (NICs), Backup Power supply and SAN storage, with off-site backup although no redundant site facility at present. There are discussions taking place as part of the Service Level Agreement development regarding moving the application to the Client Services Natural Resources (CSNR) data centres based in Calgary (delivery/test) and Kamloops (production) which are now taking orders. Windows servers in these locations are running VMWare on clustered servers and hence will be more resilient.

It is recommended that a strategy for implementing a dual redundant location at an alternate site, ideally with load balancing and failover to the other site in the case of the failure of one site or its connectivity.

There may be a cost to enhancing the application to perform in this manner both in terms of developing/implementing on the redundant architecture and potentially an increased support costs due to the higher specification platform.

One strategy to offset this cost would be to partner with another Province who may be interested in a similar concept (Common Operating Picture) and the same technologies (ArcGIS / Oracle). Another would be to partner with E-Comm who have a very similar application (E2MV) which uses the flex API and ArcGIS server, albeit on the SQL server platform.

Alignment of the platforms and support services between two partners is likely to deliver some cost savings assuming development requirements from the respective user bases is in line but that may be offset by the higher costs of supporting dual redundant infrastructures.

Another recommendation is also to upgrade the BCeMap user interface to the latest version (with the corresponding server side upgrade) such that the open source MASAS controls can be leveraged especially the MASAS publishing tool (not currently supported in BCeMap) and also WMS feeds can be consumed natively in the BCeMap user browser (currently these data sources have to be consumed by the server and served up to the client as a map service. The current arrangement is not the most performant solution).

Another potential issue as the application expands and the number of information layers it supports grows is the ease with which the application can be navigated by users. Additional layer search and selection functionality may be required (e.g. if multiple threat scenarios are supported by the WMS feature, or multiple feeds from municipal Incident Management systems, then finding the appropriate layers for display may be a challenge and some more advanced characterization (meta data) with respect to each layer and user search/filter facility on the layers may be required.

Therefore recommended investment approach to increasing resilience is to set up a project to cost, plan and promote the initiatives described above i.e.

- Dual redundant resilience and load balancing
- Upgrade to Flex Api 2.2 and ArGIS server 10.1
- Investigation of integration of the MEFT tools, also the user facilities to support feeds from multiple CAUSE hubs.
- More advanced layer search and selection facilities.

Appendix B - Detailed script used for guiding the two sessions and the filming

Morning Session

Scenario Timeline	Experiment Timeline	Locations involved	CAUSE Experiment Script Execution - Morning session	Technologies at play:	Other filming at same time		
N/A (overview of all events)	**9.30**	**All**	9:30 am - Experiment Briefing: Run through of the **overview and goals of the experiment**, and **goals for the day**, I will then run through the **earthquake scenario**, presented using some of the tools which will set the scene for what happened i.e. An M9.0 earthquake at 8am on 21st June off the coast of Oregon, with damage created over a number of communities in the lower mainland and on Vancouver Island, followed by tsunami warnings/alerts to coastal BC, a further aftershock happens an hour later, magnitude 7.1, the damage to the lower mainland BC is not expected to be massive however the main event and some more local aftershocks will cause debris, power, communications and transportation disruption in most of the communities. In the South and West of the lower mainland there will be several hundred buildings with minor to moderate damage, some ruptured gas mains and ensuing fires, some bridges may be determined to have exceeded their design limits, rock falls etc. . Some power supplies will be disrupted through falling power lines and communications affected accordingly. There are several rockslides including in the Fraser Valley Canyon and on the highway up to Squamish. More detail is included in the vignettes described below. The briefing will be an overview of the scenarios and the technologies to set the scene for the day.	**CAP/Atom message generator / MASAS / BCeMap**			
Earthquake + 24 hours Vignette2 v1 (4hrs) + Vignette2 v1 step 20 (8hrs) + Langley + MystateUSA Messages	**10.00**	**SWPREOC**	10:00 - We will be acting out some dialogue here in the SWPREOC to represent the process of getting **a regional roll-up of the overall situation** involving the different sections: getting up to speed with the situation and determining affected areas, declarations, status of CI, access routes, potential impact on population etc. This would represent the summary of **various incidents/events / damage over a 24 hour period**. Assess the situation regarding the rock falls in the Fraser valley and determine that there is a **need for** investigating the ability to **bring resources to the lower mainland from interior BC via the US** (this sets up the call to Seattle and then to the WA EMD). Damage in Langley can be brought into this one . . (Doug will inject as part of scenario introduction)	**BCeMap**	**City of Vancouver EOC/311**	Ushahidi reports being created and 311 team analysing Ushahidi reports and creating ETeam call centre reports. The significant ones being the reports and pictures relating to the Georgia Viaduct collapse.	**Ushahidi / ETEam**
Earthquake + 26 hours	**10.30**	**SWPREOC / Seattle EOC (simulated by PNNL Labs)**	10:30 – At the SWPREOC* over a video conferencing tool called Livewall, we will receive a situation report from the Seattle area and then reciprocally receive a request from the SWPREOC Director of Operations about the need for determining transportation routes from the interior BC down into the USA via Osoyoos (Highway 97), through to the coast (via Highways, 20, 2 or I90) and back into Canada via the I5 highway, this is being looked at due to **rock fall blockages in the Fraser Valley canyon**. The Director Ops will **request information on the state of the highways in the immediate vicinity of Seattle** (I5, I405 and I90) and Seattle will put up some pictures from SAMapper (a situational awareness tool) showing the state of one of he highways (e.g. major accident, congestion or bridge failure, the message can be pushed through to BCeMap or MASAS view) and can give a general overview of the state of the traffic in the area. The Director Ops will ask if they have any information for the north, this is not their jurisdiction therefore they **recommend getting hold of** Note: SWPREOC = South West Provincial Emergency Operations Centre (one of our five Provincial EOCS) . . . normally communications with the USA has to go up the ladder (provincial and federal but we are assuming in the scenario that that has been done and local level communications has been approved for situation reports and investigation of transportations routes via the US) .	**Livewall, SA Mapper, BCeMap / MASAS / MASAS Viewer**	**City of Vancouver EOC/311**	City of Vancouver EOC members reviewing call centre reports and creating incidents as needed from those reports. The significant one again being the reports relating to the Georgia Viaduct collapse. The Eteam incidents should push across to BCeMap (to be viewed in the 11am session).	**ETEam / BCeMap**

Earthquake + 28 hours	**11:00**	**SWPREOC / CoV EOC**	11:00 - The SWPREOC receives a situation report from the City of Vancouver Emergency Operations Centre centered around the **collapse of the Georgia Viaduct**, damaged through the initial earthquake and subsequently weakened by further aftershocks. As a result the City of Vancouver is having difficulty getting resources into downtown core for debris removal and are asking the SWPREOC for assistance. The dialogue can evolve to the possibility of using a Barge to get some cranes into false creek to help with debris removal, talk about the need to get an engineer down there to determine whether the foreshore and area around the plaza of nations is of sufficient grade and the cranes can get under the pieces of viaduct still standing. **Use of pictures gathered from citizen**s using Ushahidi to view the extent of the damage to the Viaduct.	**Ushahidi / Eteam / BCeMap**
Earthquake + 30 hours MystateUSAMessages	**11:30**	**SWPREOC / WA EMD**	11:30 – The SWPREOC Director of Operations receives **a situation report from Washington EMD** based on information captured in MyStateUSA and pushed to our tools via IPAWS <> MASAS <> BCeMap around the state of the highways south of the border, especially the viability of Highways 2, 20 or I90 for moving Canadian resources from the interior BC down from Osoyoos through to Vancouver through the state around or through the National Parks/forests around mount baker. The reports include **details on a chemical spill and bridge collapse on the I5 near Blaine** as captured in MyStateUSA (and hopefully pushed via IPAWS to BCeMap). This means that one of the other border crossings would have to be used (e.g. Sumas crossing). There could also be some dialogue around investigation of the possibility of using rail. The SWPREOC would then commit to informing other organisations (BCHydro, EMS etc.) with mutual aid agreements about the best possible routes and options. Close with a discussion about when the next update should be (can reference that the systems will be kept up to date and only if information that cannot be puished out automatically will there be a need for a call). 1) "MyState/WA issues CAP message for bridge closure at major border crossing, MASAS displays on map and does whatever actions are appropriate and available for test Bridge closure over Dakota Creek on Highway 5 just south of Blaine WAS issued by Whatcom County in MyStateUSA for posting into CA IPAWS COG (development 3.0 environment). 2) MyState/WA issues CAP message for road closure, MASAS displays on map and does whatever actions are appropriate and available for test. 1 3) MyState/WA issues CAP message for HazMat alert at previously closed border crossing to include plume area (I know MyState does this but not sure if it is in WA's system), MASAS show affected area on map. Hoping here we can get in the event location layer but still need to make sure Joey is up to speed with that) Sumas WA crossing east of Blaine. Reciprocally the SWPREOC gives a situation report around information pushed to MyStateUSA via MASAS <> IPAWS around the state of the highways north of the border, most notably the **closure of the Massey tunnel**, severe congestion on the **Alex Fraser bridge** as a result, and **an industrial fire sending smoke across the highway 99 in Whiterock** (just North of the border).	**MASAS / BCeMap / IPAWS / MyStateUSA**

Afternoon Session

Scenario Timeline	**Experiment Timeline**	**Locations involved**	**CAUSE Experiment Script Execution - Afternoon session**	**Technologies at play:**
Earthquake + 8 hours Vignette2 v1 (4hrs) + MystateUSAMessages + Vignette2 v1 step 20 (8hrs)	**2.30 pm**	**SWPREOC / CoR**	Situation: 8 hours after the earthquake some **information has been gathered** from BCeMap/MASAS regarding the **earthquake and aftershocks**, bridge sensors and ground shake monitors, ground shake model tool, plus some local data has been collected and entered into Emergeo regarding local incidents/events, e.g. some buildings experiencing minor to moderate damage, some fires caused by broken gas mains and other events (open to suggestions here this section to be dealt with in detail in the session at 3pm:)) **Delta has reported that the Massey Tunnel has experienced some damage due to liquefaction and is currently closed**. Unlikely to re-open in the next 72 hours. In **a situation report and resource request dialogue between CoR EOC and the SWPREOC**, Richmond CoR reports the sensor reading output and the fact that bridge sensors are reading that some bridge on ramp and off ramp sections may have **exceeded the design threshold** during one of the aftershocks and they are closed pending reports from inspectors sent to investigate. CoR can also report the level of shaking felt by people, and also report the output from their ground shake model tool in terms of peak ground acceleration and modified mercali index. CoR can **go through some of the more significant incidents/building damage/fires** etc. entered into Emergeo, and SWPREOC should be able to see that on screen through BCeMap which should have a feed from Emergio to allow that data to be seen. SouthWest **PREOCC can pull up the Hazus map** lodged with the Province for the similar earthquake scenario [**Note: this could be done before the call through dialogue with SWPREOC and Teron at the PECC?**], to **look at the estimated debris model** and how many trucks they will require over time to clear the debris. SWPREOC can make a statement that Delta has reported that they appear to have been affected a little more than Richmond since they were closer to the original earthquake and aftershocks, and have experienced more road closures, so they will receive some preference in terms of the early debris removal activities. Surrey has not reported yet so that could change and SWPREOC will keep CoR up to date. CoR can say that their **internet connectivity is somewhat patchy** because of internet congestion, they assume there is some damage to the communications infrastructure which is being investigated. Can they have some back-up communications implemented, The SWPREOC can state that the **AMECom truck is being deployed to the airport** in order to provide them with additional communications support and will **drop off a tactical microwave link** kit and team on the way to the Airport. There can be a discussion at this point about the best way to get to	**BCeMap / MASAS / Emergeo / Hazus**
Earthquake + 4 hours Vignette2 v1 (4hrs)	**3.00pm**	**CoR**	CoR - has activated and staff are arriving after making sure their families are OK. Arriving staff are being brought up to speed with the situation (gathered from BCeMap/MASAS regarding the **8.00am M9.0** earthquake and 1st significant aftershock (**9am M7.1**) both off the coast of Oregon, the **tsunami alert for Zone E coastline** (**amplitude of only 0.5m, not a concern**), the bridge sensors and ground shake monitors). **Reports have been requested from their engineers** regarding the state of the on and off ramps on the **East-West Connector and Annacis Channel bridge** and **parts of the bridge have been closed in the mean time** (other side of Annacis island to the Alex Fraser Bridge). **Reports coming in regarding local fires and damaged buildings**, this data enetered into Emergeo online . . .a conversation could take place here with CoR decision makers by phone who may be remote, and logging onto Emergeo from outside of Richmond to see what is going on and actions that need to be taken.	**BCeMap / MASAS / Emergeo**
Before the Earthquake	**3.30pm**	**CoR + NRCan (at CoR) + EMBC Victoria (on the phone)**	Planning session between NRCan and CoR regarding the **estimation of debris removal from Richmond** under the scenario of a Casacadian Subduction zone M9.0 earthquake. There can be a dialogue between Murray/Nicky and Amy regarding **the latest updates to the data in the Hazus tool** (e.g. better extracts of asset data from various sources, and soil liquefaction maps and and refinements done to the scenarios e.g. **better models** for subduction zone type quake.) the discussion can include the **need to add and refine the data with more information** from their local systems and then the models will output better data. The demo can then move onto **selection of the model and execution of the model analysis** and discussion around what the debris outputs mean - classification of the different types of debris and the ability to plan the removal and disposal by truck, and how many trucks based on the size of trucks. The discussion **should include confirmation by Teron that the latest version can be lodged with the province** as a reference model to be used for cross-jurisdictional planning purposes and for assessment of relative damage and prioritisation between communities in the event.	**Hazus**
	4.00pm	**CoR**	**Interviews**	

Glossary

NAME	DEFINITION
AMECom	Advanced Mobile Emergency Communications
AHRA	All Hazards Risk Approach
AIMS	Asset Inventory Management System
BCERMS	British Columbia Emergency Response Management System
BCSIMS	British Columbia Smart Infrastructure Systems
CAP	Common Alerting Protocol
CAP-CP	Common Alerting Protocol – Canadian Profile
CSS	Centre for Security Science
DHS	(US) Department of Homeland Security
DRDC	Defence Research and Development Canada
EOC	Emergency Operations Centre
EMBC	Emergency Management British Columbia
EMIS	Emergency Management Information Service
FEMA	(US) Federal Emergency Management Agency

NAME	DEFINITION
ICS	Incident Command System
IPAWS	Integrated Public Alert Warning System
LRDW	Land and Resource Data Warehouse
MASAS	Multi-Agency Situational Awareness System
NIEM	National Information Exchange Model
NIT	(MASAS) National Implementation Team
NRCan	National Resources Canada
NWS	(US) National Weather Service
OPEN	Open Platform for Emergency Networks
PEOC	(BC) Provincial Emergency Operations Centre
PNNL	Pacific Northwest National Laboratory
REOC	(BC) Regional Emergency Operations Centre
SFU	Simon Fraser University
SOREM	(CA) Senior Officials Responsible for Emergency Management
TRIM	Terrain Resources Inventory Mapping

NAME	DEFINITION
UBC	University of British Columbia
UICDS	Unified Incident Command and Decision Support
USGS	US Geological Survey
WMS	Web Mapping Service

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The CAUSE Resiliency (West Coast) Experiment jointly sponsored by the Department of Homeland Security (DHS) and the Defence Research and Development Canada (DRDC) was conducted in June 2011. Emergency management communities in British Columbia and Washington State participated and were exposed technologies that have recently been developed or are nearing operational maturity. This report provides an overview of the experiment and summary of the findings and recommendations.

En juin 2011, des organismes de gestion des urgences opérationnelles en Colombie-Britannique et dans l'État de Washington ont participé au projet expérimental CAUSE Resiliency (côte ouest), parrainé conjointement par le département de la Sécurité intérieure (DHS) et Recherche et développement pour la défense Canada (RDDC). Ils ont été exposés à des technologies récentes ou approchantes la maturité opérationnelle. Ce rapport donne un aperçu de l'expérience, en plus de résumer les résultats et les recommandations.

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